

REGISTER
OF
THE LEHIGH UNIVERSITY,
SOUTH BETHLEHEM, PA.
1897-1898.

FOUNDED BY ASA PACKER.

LANCASTER, PA.
THE NEW-ERA PRINTING COMPANY.

1898

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TABULAR ALMANAC.

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CALENDAR

1897.

Sept. 18, 20, 21,	Examinations for Admission.
Sept. 22,	First Term begins.
Oct. 14,	Founder's Day.
Nov. 25,	Thanksgiving Day.
Dec. 22, 12 ½ P. M.,	Christmas Holidays begin.

1897-1898.

1898.

Jan. 3, 8 ¼ A.M.,	Christmas Holidays end.
Jan. 15,	Junior Prize Orations due.
Feb. 2,	First Term ends.
Feb. 3, 8 ¼ A. M.,	Second Term begins.
Feb. 22,	Washington's Birthday.
April 6, 12 ½ P. M.,	Easter Holidays begin.
April 13, 8 ¼ A. M.,	Easter Holidays end.
May 21,	University Day Orations due.
May 25,	Senior Examinations begin.
June 6,	Annual Examinations begin.
June 8,	Graduation Theses due.
June 12,	Baccalaureate Sunday.
June 13,	Class Day.
June 14,	Alumni Day.
June 15,	University Day.
June 16-July 9,	Summer School of Surveying.
June 16, 17, 18,	Examinations for Admission.

1898.

Sept. 17, 19, 20,	Examinations for Admission.
Sept. 21,	First Term begins.
Oct. 13,	Founder's Day.
Dec. 22, 12 ½ P. M.,	Christmas Holidays begin.

1898-1899.

1899.

Jan. 3, 8 ¼ A.M.,	Christmas Holidays end.
Feb. 2,	Second Term begins.
June 14,	University Day.

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357 Market Street, Bethlehem.

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542 North Street, Bethlehem.

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Assistant Professor of Metallurgy, Mineralogy, and Blowpiping.

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WILLIAM H. CHANDLER, PH.D.

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A. W. STERNER.

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THE LEHIGH UNIVERSITY.

ORIGIN.

The HON. ASA PACKER, of Mauch Chunk, during the year 1865, appropriated the sum of \$500,000, to which he added one hundred and fifteen acres of land in South Bethlehem, to establish an educational institution in the rich and beautiful Valley of the Lehigh. On this foundation rose THE LEHIGH UNIVERSITY, incorporated by the Legislature of Pennsylvania in 1866. In addition to these gifts, made during his lifetime, Judge Packer by his last will secured to the University an endowment of \$1,500,000, and to the University Library one of \$500,000.

DESIGN.

The original object of Judge Packer was to afford the young men of the Lehigh Valley a complete education, technical, literary, and scientific, for those professions represented in the development of the peculiar resources of the surrounding region. In furtherance of this purpose instruction is liberally provided in Civil, Mechanical, Mining, and Electrical Engineering, Metallurgy, Chemistry, and in all needful collateral studies. A School of General Literature is also established and thoroughly equipped, and includes the Classical course, the Latin-Scientific course, and the course in Science and Letters.

TUITION.

The following charges are made for tuition :

For students in the Technical courses, \$100 per annum: \$60 for the first term, \$40 for the second term; for students in the school of General Literature, \$60 per annum: \$40 for the first term, \$20 for the second term.

These fees include all tuition, with the use of the Library and Gymnasium, but the student is charged for materials and apparatus consumed in the Laboratories.

The Trustees have placed at the disposal of the Faculty a limited number of scholarships, to be awarded to applicants of good moral character who shall pass the entrance examinations creditably, and who for other cause shall be regarded as worthy by the Faculty.

Through the kindness of friends of the University, provision has been made for the awarding of a limited number of free scholarships to students taking the Classical Course who in other respects fulfil the above conditions.

Application for these free scholarships should be made to the President of the University, who will furnish all needed information concerning the regulations which govern their bestowal.

All fees for tuition are payable to the Treasurer of the University in two instalments, as above. The first instalment is to be paid to the Treasurer of the University on or before October 10th; the second on or before February 10th.

Students who fail to pay tuition fees when due will be notified by the President that their attendance at college exercises must be discontinued until payment is made.

Every candidate for a degree is required to pay a graduation fee of \$10, before the degree is conferred.

PUBLIC WORSHIP.

Prayers are held in the Packer Memorial Church of the University every morning, the attendance being voluntary.

Divine service is held every Sunday morning in the church. Any student who may desire to attend some other place of worship will be permitted to do so upon the request of his parent or guardian or, if he be 21 years of age, upon his own request. The request for such permission should be renewed at the beginning of each term. Attendance, either at the Packer Memorial Church or at the church of his selection, is required of every student.

SITE.

The situation of the institution is healthful and beautiful. The region is famous for its railway and manufacturing enterprises ; it possesses some of the richest iron and coal mines in our land, and thus gives the students rare facilities for confirming the teachings of the recitation room by the observation of the eye.

South Bethlehem is situated at the junction of the Lehigh Valley, the New Jersey Central, and the Reading (North Pennsylvania) Railroads, and the University buildings are about a half-mile from the station. New York is eighty-seven and Philadelphia fifty-eight miles distant.

BUILDINGS.

PACKER HALL.

This building, completed in 1869, is four stories in height, 215 feet long, and mostly 60 feet in width. It is built of Potsdam sandstone in the English Gothic style of architecture, and occupies a commanding position, overlooking Bethlehem, West Bethlehem, and South Bethlehem. It contains the lecture and recitation rooms of the departments of Greek, Latin, Modern Languages, History, and Mathematics.

The department of Civil Engineering has, on the first floor, two drawing rooms and three lecture rooms, together with instrument rooms and offices. Here are found collections of bridge models, photographs and blue prints, specimens of building materials, and also a large number of levels, transits, and other surveying instruments. The testing laboratory in the basement has a 150,000-pound Riehle machine for tests of tension, compression, and flexure ; a 2,000-pound Olsen cement machine, and smaller apparatus for special experiments on beams and columns. The Freshman drawing room of the Civil Engineering department is located on the fourth floor.

The second floor of this building is devoted to the class room and drafting work of the department of Mechanical

Engineering. Here are the various recitation rooms, and the well lighted and equipped drafting rooms for the several classes. Near these are the offices of the professor and instructors, the blue print room, and the reference library of the department with its large store of prints and working drawings. A wide range of machinery is illustrated by cuts and photographs on the walls. The drafting rooms are further equipped with an extensive assortment of machine parts in cases, with a full sized link motion constructed for Lehigh Valley Railroad practice, and with a small eight-wheel locomotive, which is an exact reproduction on a scale of one-sixth of a standard passenger locomotive, and which is noticeable for its exact workmanship and delicate finish.

On the third and fourth floors are to be found the lecture and drawing rooms of the department of Mining Engineering and Geology, the museum of geology and natural history, and other class-rooms.

THE CHEMICAL LABORATORY.

This is a thoroughly fire-proof building, built of sandstone, and 219 feet in length by 44 in width.

There are two principal stories and a basement. The upper floor is occupied by the quantitative and the qualitative chemical laboratories, the former accommodating 48 and the latter 84 students. These rooms are 22 feet in height, and are well lighted and ventilated. A laboratory for industrial chemistry and the supply room are also on this floor.

The first floor contains a large lecture room, a recitation room, a chemical museum, and laboratories for organic, physiological, agricultural, and sanitary chemistry.

In the basement is the large laboratory for the furnace assay of ores and a well appointed laboratory for gas analysis, also rooms containing the apparatus for several processes in industrial chemistry, the engine and air-pump for vacuum filtration, a store room, and the toilet.

A photographic laboratory is located in the third story of the central portion of the building.

THE METALLURGICAL LABORATORY

contains a lecture room, a blowpipe laboratory for class instruction in blowpipe analysis and in the practical determination of crystals and minerals, a museum for mineralogical and metallurgical collections, a mineralogical laboratory provided with a Fuess reflecting goniometer, a polariscope, a Groth's "universal apparatus," and a Rosenbusch polarizing microscope, a dry laboratory provided with furnaces for solid fuel and for gas with natural draught and with blast, and a wet laboratory for ordinary analytical work. It is arranged for the instruction of classes in the courses of mineralogy, metallurgy, and blowpipe analysis of the regular curriculum, and to afford facilities to a limited number of advanced students for familiarizing themselves with the methods of measurement and research employed in mineralogy and metallurgy, and for conducting original investigations in these departments of science.

THE PHYSICAL LABORATORY.

This is a stone building, 235 feet long, 44 feet wide, and four stories high. On the first floor are the dynamo laboratory, the workshop, the battery room, and research rooms for thesis work. The dynamo laboratory is provided with a 50 horse-power steam engine and is well equipped with electrical machinery and measuring instruments. In the workshop a 6 horse-power electric motor drives three lathes, a drill-press, an emery grinder, and a buzz-saw; and an 80-cell storage battery is installed in the battery room.

On the second floor are the designing room, the beginnings of an electro-technical museum, the electrical laboratories, and a department library and reading room.

On the third floor are the physical lecture-room, with apparatus rooms adjoining, a large audience hall, and recitation rooms; and on the fourth floor are the laboratories for general physics, light, and photography, and two recitation rooms.

SAUCON HALL.

Extensive alterations to this building have recently been made, adapting it to the needs of the department of English. It is well warmed and lighted, and contains a study and a recitation room for each instructor, a hall for lectures seating 150 persons, a large room on the ground floor which has been fitted up for the use of the Debating Societies, with committee rooms adjoining, and the offices of the Brown and White. A set of rooms on the second floor has been set aside for the use of the Alumni, where they now have a comfortable office, a committee room, and a safe and commodious place for storing their archives. It is proposed to make further improvements in the building in the near future.

THE SAYRE OBSERVATORY.

Near Brodhead Avenue is the Sayre Observatory, the gift of Robert H. Sayre, Esq., of South Bethlehem, containing an equatorial and a zenith telescope, transit instrument, and astronomical clock.

THE PACKER MEMORIAL CHURCH

is the munificent gift of Mrs. Mary Packer Cummings, daughter of the Founder of the University. It is one of the largest and most magnificent churches in the State, richly furnished and handsomely appointed in every particular.

THE UNIVERSITY LIBRARY.

To the east of Packer Hall is the University Library, erected by the Founder in memory of Mrs. Lucy Packer Linderman, his daughter.

THE GYMNASIUM

is a handsome and spacious structure, built and equipped with the utmost thoroughness. It is furnished with the best patterns of gymnastic apparatus, besides Dr. Sargent's system of developing appliances. It is provided with hot and cold water; tub, sponge, and shower baths, and 389

clothes closets. Opportunities for recreation and amusement are provided in the bowling alleys. It is under the immediate care of a skilled and competent Instructor.

All students are required to undergo a physical examination before being allowed the use of the Gymnasium, and this examination will be repeated once each year during their stay at the University. The proper exercise is prescribed and is required of every student. These regulations are designed to promote the harmonious, symmetrical development of the individual student.

EXPENSES.

Books, materials, paper, pencils, materials used in the laboratories, and drawing instruments are furnished by the student. Materials consumed in the laboratories can be obtained from the University, their value being covered by a deposit made at the opening of that term in which the laboratory work is to be done.

Rooms and board cannot be had in University buildings, but can readily be obtained in many private houses.

The following is an estimate of the necessary expenses for the collegiate year, clothing and traveling not included :

Tuition, ...	\$100	\$100
Board for 36 weeks, ...	from 126 to	180
Room-rent, with fuel and light, . .	40 "	80
Care of room and use of furniture, . .	5 "	20
Washing and incidentals, ...	20 "	40
Books, stationery, etc, ...	25 "	50
Total, ...	\$316 to	\$470

(In the case of students in the School of General Literature, the charge for Tuition is \$60, and the totals are \$276 to \$430.)

ADMISSION OF STUDENTS.

The Register is intended to give all necessary information concerning the admission of students. Application may be made to the President of the University if information is desired which is not given in the Register.

DATE OF EXAMINATIONS.

Examinations for admission to the University are held at the opening of each term, and also in June at the close of the academic year.

The examinations for 1898 will be on Thursday, Friday, and Saturday, January 27, 28, and 29, for admission to the second term; on Thursday, Friday, and Saturday, June 16, 17, and 18, and on Saturday, Monday, and Tuesday, September 17, 19, and 20, for admission to the first term. No other examinations for admission will be held, except for good cause, and all applicants *must* be in attendance at 8.30 o'clock on the morning of the first day.

The examinations are held in June and September in the following order:

First Day.—English, 8.30 A.M.; Physics, 2 P.M.; Latin and Roman History, 2 P.M.

Second Day.—Geometry, 8.30 A.M.; Physical Geography, 11.30 A.M.; United States History, 3 P.M.

Third Day.—Algebra, 8.30 A.M.; German or French, 2 P.M.; Greek and Greek History, 2 P.M.

The schedules of examinations for applicants for admission to the Freshman Class at the beginning of the second term and to the Sophomore Class at the beginning of the first term may be obtained from the Secretary of the Faculty. Examinations at other than the appointed times can not be granted without great inconvenience, and candidates so

applying will be required to pay a fee of \$5 into the Faculty's fund for the aid of indigent students.

CHARACTER OF THE EXAMINATIONS.

The examinations are rigorous and cover the entire ground laid down in the following scheme. They are all conducted in writing, supplemented by an oral examination at the option of the examiner.

Each candidate for admission must be at least sixteen years of age, and must present a testimonial of good moral character from his last instructor, or from the school or institute to which he last belonged, or from some reputable citizen of the community in which he lives.

Candidates for admission to

THE CLASSICAL COURSE

are examined in the following subjects :

1. *English*.—This requirement includes : (a) English Grammar, especial attention being given to the analysis and correction of sentences ; and (b) Rhetoric and Composition. Any High School Rhetoric, such as those of Hart, Hill, Williams, Kellogg, and others of a like grade, will be sufficient, together with practical exercises in composition.

Greater stress will be laid, year by year, upon accurate and idiomatic use of the vernacular, upon correct pronunciation, clearness and facility in expression and in the presentation of ideas, an acceptable style in writing—in short, upon all that may fairly be expected of the student as the result of a thorough and intelligent preparation in English. To gain this end, it may be well to use the list of books prescribed for admission to the colleges of the Middle States. These are, for 1898 :

Milton's *Paradise Lost*, Books I and II ; Pope's translation of the *Iliad*, Books I and XXII ; the Sir Roger de Coverly Papers in *The Spectator* ; Goldsmith's *Vicar of Wakefield* ; Coleridge's *Ancient Mariner* ; Southey's *Life of*

Nelson ; Carlyle's Essay on Burns ; Lowell's Vision of Sir Launfal ; Hawthorne's House of the Seven Gables ; Shakespeare's Macbeth ; Burke's Speech on Conciliation with America ; De Quincey's Flight of a Tartar Tribe ; Tennyson's The Princess.

From one of the last four books in this list a theme will be taken for the composition which forms a part of the examination paper.

The student is also urged to the fullest possible use of all the opportunities for vocal culture which his means of preparation afford.

Attention is called to the fact that the right is reserved to regard hereafter all examination papers, upon whatever subject, as part of the English examination.

2. *History of the United States*, including the *Constitution*.

[Montgomery's Leading Facts of American History and Fiske's Civil Government may serve to indicate the amount and character of this requirement.]

3. *Algebra*. — Fundamental principles. Factoring. Least common multiple. Greatest common divisor. Fractions. Involution. Evolution. Radicals. Imaginary quantities. Equations of the first and second degrees. Ratio. Proportion and progressions.

4. *Geometry*. — Fundamental principles. Rectilinear figures. The circle. Proportional lines and similar figures. Comparison and measurement of the surfaces of rectilinear figures. Regular polygons. Measurement of the circle. Maxima and minima of plane figures, and plane and polyhedral angles.

Candidates must have a knowledge of the metric system and be prepared to solve problems in either Algebra or Geometry involving the use of metrical units.

5. *Physical Geography*.

6. *Latin Grammar*.

7. *Cæsar*, four books of the Gallic war.

8. *Cicero*, six orations, including the four against Catiline.

9. *Vergil*, the first six books of the *Æneid*, including Prosody.

10. The translation, at sight, of passages from *Cæsar* and *Cicero*.

11. The translation of English into Latin. (As special importance is given this part of the examination, it is suggested to teachers that they connect exercises in making Latin, both oral and written, with all the studies of the preparatory course.)

12. *Roman History*.—Creighton, Pennell, or Myers.

13. *Greek Grammar*.

14. *Xenophon*, *Anabasis*, four books.

15. *Homer*, *Iliad*, first three books, including Prosody. The Catalogue of Ships may be omitted.

16. The translation, at sight, of a passage from some work of *Xenophon*.

17. *Greek History*.—Fyffe, Pennell, or Myers.

The pronunciation of Greek according to the written accents is followed in the University, and it is desirable that students preparing to enter be taught this system.

Latin is pronounced according to the method generally known as the Roman Method.

Candidates for admission to the Classical Course who have had, in their preparatory schools, no opportunity of studying Greek, will be admitted to that course in full standing upon presenting an amount of French or German equivalent to two years' work. They will begin Greek in the University and study it throughout the course, and will then receive the degree of B.A.

THE LATIN-SCIENTIFIC COURSE.

Candidates for admission to this course must present the first twelve of the above requirements, but substitute for

the Greek sections (numbers 13-17 inclusive) the following:

18. *German*.—This requirement will be satisfied by the completion of an amount equivalent to Part I. of Joynes-Meissner's or Calvin Thomas's Grammar, Buchheim's Reader, and additional reading.

[An equivalent amount of French will be accepted in cases in which it is inconvenient for the candidate to offer German. The amount thus required in French is equivalent to Whitney's Practical Grammar and Super's Reader, with additional reading.]

The candidate is expected to have acquired the ability to understand simple German (or French) prose, by the careful reading of about two hundred duodecimo pages, in addition to the study of Grammar. His proficiency will be tested by questions on the rudiments of grammar, by translations of simple English sentences, and by translations at sight of passages of easy German (or French) prose, containing no rare words.

THE COURSE IN SCIENCE AND LETTERS.

Candidates for admission to this course are examined in all the subjects demanded of those entering the Latin-Scientific Course, except the Latin and Physical Geography sections (numbers 5-12 inclusive). They also present the following:

19. *Elementary Physics*.

[Nichols's Outlines of Physics, Gage's Elements of Physics, or Avery's Elements of Natural Philosophy (revised edition).]

In 1899, and thereafter, candidates for admission to the Latin-Scientific course and to the course in Science and Letters will be examined in Solid Geometry, in addition to the subjects named above.

THE SCHOOL OF TECHNOLOGY.

Candidates for admission to the Courses in Civil Engineering, Mechanical Engineering, Mining Engineering, Electrical Engineering, and Chemistry, are examined in the following subjects :

1. *English*.—This requirement includes: (a) English Grammar, especial attention being given to the analysis and correction of sentences; and (b) Rhetoric and Composition. Any High School Rhetoric, such as those of Hart, Hill, Williams, Kellogg, and others of a like grade, will be sufficient, together with practical exercises in composition.

Greater stress will be laid, year by year, upon accurate and idiomatic use of the vernacular, upon correct pronunciation, clearness and facility in expression and in the presentation of ideas, an acceptable style in writing,—in short, upon all that may fairly be expected of the student as the result of a thorough and intelligent preparation in English. To gain this end, it may be well to use the list of books prescribed for admission to the colleges of the Middle States. These are for 1898:

Milton's *Paradise Lost*, Books I and II; Pope's translation of the *Iliad*, Books I and XXII; The Sir Roger de Coverly Papers in *The Spectator*; Goldsmith's *Vicar of Wakefield*; Coleridge's *Ancient Mariner*; Southey's *Life of Nelson*; Carlyle's *Essay on Burns*; Lowell's *Vision of Sir Launfal*; Hawthorne's *House of the Seven Gables*; Shakespeare's *Macbeth*; Burke's *Speech on Conciliation with America*; De Quincey's *Flight of a Tartar Tribe*; Tennyson's *The Princess*.

From one of the last four books in this list a theme will be taken for the composition which forms a part of the examination paper.

The student is also urged to the fullest possible use of all the opportunities for vocal culture which his means of preparation afford.

Attention is called to the fact that the right is reserved to regard hereafter all examination papers, upon whatever subject, as part of the English examination.

It is recommended that candidates have a knowledge of Latin Grammar, although an examination in it is not required for any courses except the Classical and the Latin-Scientific.

2. *History of the United States*, including the *Constitution*.

[Montgomery's Leading Facts of American History and Fiske's Civil Government may serve to indicate the amount and character of this requirement.]

3. *Algebra*.—Fundamental principles. Factoring. Least common multiple. Greatest common divisor. Fractions. Involution. Evolution. Radicals. Imaginary quantities. Equations of the first and second degrees. Ratio. Proportion and progressions.

4. *Geometry*.—Fundamental principles. Rectilinear figures. The circle. Proportional lines and similar figures. Comparison and measurement of the surfaces of rectilinear figures. Regular polygons. Measurement of the circle. Maxima and minima of plane figures, and plane and polyhedral angles. Solid Geometry.

Candidates must have a knowledge of the metric system and be prepared to solve problems in either Algebra or Geometry involving the use of metrical units.

5. *Elementary Physics*.

[Nichols's Outlines of Physics, Gage's Elements of Physics, or Avery's Elements of Natural Philosophy (revised edition).]

6. *German*.—This requirement will be satisfied by the completion of an amount equivalent to Part I. of Joynes-Meissner's or Calvin Thomas's Grammar, Buchheim's Reader, and additional reading.

[An equivalent amount of French will be accepted in cases in which it is inconvenient for the candidate to offer German. The amount thus required in French is equivalent to Whitney's Practical Grammar and Super's Reader, with additional reading.]

The candidate is expected to have acquired the ability to understand simple German (or French) prose, by the careful reading of about two hundred duodecimo pages, in addition to the study of Grammar. His proficiency will be tested by questions on the rudiments of grammar, by translations of simple English sentences, and by translations at sight of passages of easy German (or French) prose, containing no rare words.

Division of Examinations for Admission.

Candidates for admission to the Freshman Class may pass all the examinations in June, or all in September, or partly in June and partly in September, or may take them in *two consecutive years*. In the latter case, for the Technical courses and the course in Science and Letters, candidates may present themselves for examination in the first year in the following subjects: English, History of the United States, and German. No credit will be given unless the candidate has passed satisfactorily in at least two subjects in one year.

The examinations in Algebra, Plane and Solid Geometry, and Physics must be passed in June or September of that year in which the candidate proposes to enter the University.

In the Latin-Scientific and Classical courses candidates may present themselves for examination in the first year in the following subjects: English, History of the United States, Physical Geography, Roman History, and Greek History. No credit will be given unless the candidate has passed at least three of the subjects in one year.

The examination in Latin may also be divided, but no credit will be given unless the candidate has passed in at least three of the topics specified at one examination. The examinations in the remaining subjects must be passed in June or September of that year in which the candidate proposes to enter the University.

Candidates intending to enter the University in September are advised to present themselves for examination in

June ; if they are not fully prepared at that time they will receive credit for the examinations then satisfactorily passed.

CONDITIONAL ADMISSION.

A candidate failing to pass in one or more of the subjects required for admission may, at the discretion of the Faculty, be admitted to his class conditionally, to make up his deficiencies by extra study. When they are made up he will be received into full standing in his class.

SPECIAL STUDENTS.

Young men of advanced standing, who do not desire to take a full regular course, can enter and select special shorter courses, with the sanction of the Faculty ; but in all cases satisfactory examinations must be passed upon the subjects required for entrance to the Freshman Class.

ADMISSION TO ADVANCED STANDING.

Candidates for admission to advanced studies *in any course* are required to pass, *in addition to the entrance examinations for that course*, examinations in the work already done by the classes which they desire to enter. These examinations are held on the same days as those for entrance to the Freshman Class.

The additional subjects may be found in the program of studies.

A diploma showing that a degree has been conferred, or a certificate of studies taken at another college will be received, in so far as it covers the subjects required for entrance, in lieu of the *Primary Entrance Examinations only*.

ADMISSION TO GRADUATE COURSES.

Students of this University who have taken their *first* degree, and others, on presenting a diploma of an equivalent degree conferred elsewhere, are admitted to advanced studies, according to the plan to be found in the Register under the general subject of Graduate Students.

PREPARATORY SCHOOL CERTIFICATES.

Certificates are not accepted from any schools in lieu of examinations as evidences of proficiency in Algebra, Geometry, or German, and they will not, as a rule, be accepted in any subject. It is, however, regarded as highly desirable that the examiners should receive from principals of preparatory schools statements with reference to those whom they send up as candidates for entrance, indicating as clearly and fully as possible, in each case, the teacher's opinion of the candidate's character and scholarship and fitness for entering upon collegiate work ; **and such statements will receive careful consideration, in connection with the results of the entrance examinations.**

PROGRAM OF STUDIES.

Showing the number of Exercises per week for each subject and the Text-books Used.

The following is presented as the general program of instruction, subject to such modifications from time to time as the Faculty may deem expedient, with the approval of the Trustees.

The names of the text-books studied are generally mentioned. The number of exercises per week in each subject is indicated by the figure in parentheses immediately following.

Two hours of drawing, three of work in the laboratory, or three of practice in the field, are regarded as equivalent to a recitation or lecture of one hour's duration.

SCHOOL OF GENERAL LITERATURE.

There are three courses in the School of General Literature of the University.

I. The Classical Course includes all that is prescribed in our best institutions for the degree of Bachelor of Arts (B.A.). It covers full instruction in Greek, Latin, English, French and German, Mathematics, Astronomy, Physics, Chemistry, Geology, Physiology, Hygiene, History, Psychology, Ethics, Philosophy, and Political Economy.

II. The Latin-Scientific Course differs from the first in omitting Greek, taking in its place an increased amount of the Modern Languages and of Mathematics. Students completing this course receive the degree of Bachelor of Science (B.S.).

III. The Course in Science and Letters, for which the same degree is given as for the last mentioned, contains no Latin or Greek, but furnishes instead extended instruction in French and German, History, General Literature, Mathematics, and General Science.

Instruction in all of these courses is given both by recitations and by lectures.

A student taking a literary course will be permitted to substitute, at the discretion of the Faculty, studies offered in one or another of the technical courses for a portion of the required work during Junior and Senior years. Such a student will receive the literary degree at the end of the fourth year. If he then desires to pursue the remaining branches in the technical course, he may receive the appropriate degree as soon as this is completed. The amount of additional time thus occupied will be probably from one and a half to two years, depending upon the course selected and the diligence of the student.

It is believed that the benefit from such a combined course, which unites the advantages of literary training with those of a professional course, will recommend itself to many persons, and that the maturer condition of the student when he approaches his later work will enable him to make better use of the opportunities then afforded him.

DESCRIPTION OF THE COURSES.

GREEK.—During the first term of Freshman year the class reads several books of the Odyssey, giving attention to epic forms and syntax, to prosody and scanning, and to Homeric antiquities and mythology. The work of the second term is directed toward a thorough acquaintance with the idiom and vocabulary of Attic prose, as a preparation for rapid reading. The *Œconomicus* and Symposium of Xenophon and the Crito of Plato are read during the term, with sight readings from the Memorabilia and the Apology; accompanied with discussions of domestic life at Athens. The work of the year includes a thorough re-

view-drill on the principles of Greek accidence and syntax, and exercises in Greek prose composition are required, based, during the second term, on the reading done by the class. Greek history is studied, during the second term, with special reference to the development of political institutions.

The Sophomore Class takes up, during the first term, the study of Herodotus and Thucydides. Selections are made from both authors with the purpose of illustrating their best style and, at the same time, of presenting, from the original sources, the history of certain interesting epochs; the reading from Herodotus, after some drill on the Ionic forms, being in large part at sight. During the second term the class reads one or two plays of Euripides, with attention to the history of Greek tragedy, the life of the author, and the analysis of the drama read. The lyric meters are studied, with the aim of gaining a knowledge of the rhythmical and metrical principles of Greek poetry. During this term an elective course is offered, the subject being Greek oratory, with the reading of certain orations of Lysias or Demosthenes, or both.

The Junior year is devoted to a further study of the drama, selected plays of Sophocles, Aristophanes, and Æschylus being read during the year. Work is also done in the study of public and private antiquities, partly in lectures by the professor and partly in original investigation on allotted subjects by the students.

During the first term of the Senior year the class reads either selections from Thucydides, or one of the dialogues of Plato. The second term is in part devoted to the reading of selected odes of Pindar, with careful study of the history of Greek lyric poetry and of the life and work of Pindar in particular. The course concludes with a review of the history of Greek literature, intended to summarize and harmonize the fragmentary views of the general subject gained from the study of particular authors and departments of literature.

Students who have presented a modern language for admission instead of Greek will, during Freshman and Sophomore years, cover the ground laid down in the entrance requirements. During Junior and Senior years they will take the Freshman and Sophomore courses, as outlined above.

LATIN.—Much of the training in the Freshman year is devoted to laying a good foundation in Latin grammar and in the translation of English into Latin. The authors studied are used to illustrate both of these, and a large amount is read at sight in order to cultivate quickness and readiness in the student. Roman history is begun, accompanied with full comments and lectures upon points of interest. Collateral reading will also be recommended each year throughout the course. Cicero: *De Senectute* and *De Amicitia* or the *Philippics*, Livy, and the *Odes* and *Epodes* of Horace are read this year. With the last named, training is given in Latin meters.

During this and the following year courses of lectures are given upon Roman antiquities in addition to a text-book. The topography of Rome with its remains, ancient life in its various aspects, and the other departments of archæology are discussed, illustrated by the new and extensive set of over 3,600 magic lantern slides which have been prepared for this purpose.

The Sophomore year completes the text-book on Roman history. The *Satires* and *Epistles* of Horace are read in the first term, and in the second the *Agricola* and *Germania*, with selections from the *Annals* of Tacitus, or *Quintilian*, together with sight reading.

In the Junior year, selected letters of Cicero and Pliny are read, followed by Persius and several plays of Terence and Plautus. The history of Roman literature is entered upon in the second term.

The work in the Senior year opens with Lucretius, accompanied with lectures on Roman philosophy. The course in the second term this year includes the study of ancient Latin, using Allen's *Remnants of Early Latin*,

supplemented by a series of lectures upon Latin Grammar and the history of the development of the language, together with several lectures upon the history of classical philology. Characteristic poems by various authors will be read with full comment and training in the discussion of the literary and critical points which come up.

ENGLISH.—During the first term, Freshman year, Rhetoric is studied, both with the aid of a text-book and through practical exercises, with the design of stimulating invention and imparting the essentials of a clear prose style. In the second term, a brief history of the language is made the nucleus of work. A general view of American literature is given in weekly lectures.

The Sophomores spend the first term in a careful study of all that is most typical in English literature; the second, in a critical study of the prose of DeQuincey, Macaulay, and Carlyle, following that with a rapid survey of English prose from the XIV to the XIX century.

The Juniors study models of the best Oratory, both English and American, as a preliminary to the writing and delivery of original orations at some time during the first term; and, during the second, specimens from the works of standard Essayists as models for original essays; with these alternate critical studies of the Elizabethan Drama. Careful training is given in the writing and criticism of essays throughout the course. These will be frequent rather than long; on subjects partly literary and in part technical; and the student will be led to maintain a specific thesis with orderly balance of arguments and arrangement of parts.

Excellence in Oratory is encouraged by the annual contest for the Alumni Prizes, held on the 22d of February, and open to students of the Junior class in all courses.

Instruction in elementary Anglo-Saxon is given regularly for one term to the Juniors in the School of General Literature, to be followed in the next term by a more critical study of the philology and history of the language than would be possible without such an introduction.

Seniors in the same school receive instruction in the early English of Chaucer and his contemporaries, and in the principles and practice of versification. They are required to write a short poem, or a critique of some book, of a purely literary cast, selected for their examination and review. The course is completed by a series of lectures on the English poets from Chaucer to Tennyson, and, later, by lectures on special topics in English Literature too important to be passed over with brief mention, yet too comprehensive to be treated earlier in the course. Topics for 1898 will be taken from the following list: (1) The Transition from Anglo-Saxon to English Literature. (2) Wycliffe and the English Bible. (3) Chaucer's *Canterbury Tales*. (4) Langland's *Vision of Piers the Plowman*. (5) Gower. The Condition of England, Social and Literary, in 1400. (6) The Unproductive Period after the death of Chaucer. Early Scottish Poetry.

Optional courses will be offered as occasion arises. A Reading Club will be formed, and the student will be encouraged to such private and supplementary reading as his time will permit, and to the formation of a small library of standard books.

MODERN LANGUAGES.—The study of modern languages is obligatory from the first term of the Sophomore year up to the close of the course. The student elects either French or German; or both, if time permits.

French.—The grammar is begun, reading being introduced immediately. The comparative and historical relations of the French to the English, and the connections of both with the Latin are carefully explained. As soon as possible, the student is emancipated from the Reader and takes up, in a progressive way, the reading of different authors; preference being given to modern writers, because it is considered to be of the highest importance that he acquire the language as it is, as an instrument whereby further knowledge can be obtained.

In the class-rooms, the language taught is used by the

teacher as much as possible, in order that the ear of the pupil may become accustomed to its sound. Dictation is also employed, in order to give training in spelling. The rules of grammar are taught by numerous written exercises. In the second term of the Junior year, compositions in French are required, upon subjects which have been previously explained in French, in order that the student may become acquainted with different expressions and forms of construction. Before entering upon the study of an author's works, his life and literary achievements are discussed in French, which is translated, if necessary. In the Senior year, twelve lectures are delivered upon the history of French literature. In addition to this, lectures in French upon the most distinguished modern authors are given to advanced students.

A weekly conversation-class affords opportunity for this kind of practice ; and in it the events of the day and various historical and literary topics are discussed. Private courses of reading are also suggested to those who desire it.

German.—The German course follows the same plan as that laid down for the French, both as regards the methods employed and the opportunities afforded. The relations of English and German are dwelt upon and also those which connect the two languages with the Indo-European family.

MATHEMATICS.—While preparation in solid geometry is not at present required for entrance to the literary courses, it will be found of advantage for those who propose to take one of these courses to study that subject, if opportunity offers, at the preparatory school. They will in that case be able to pursue the study of mathematics in the University in the same order as those who are taking technical courses. For those who have not studied solid geometry before entrance, the mathematical work is carried on during the Freshman and Sophomore years as follows :

Freshman year, first term, solid geometry, four exercises per week ; plane trigonometry begun.

Second term, analytical geometry ; plane and spherical

trigonometry, including mensuration and use of logarithmic tables: together five exercises per week throughout the term.

Sophomore year, first term, higher algebra, three exercises per week.

Opportunity for the study of more advanced mathematics is given in the elective work of the Junior and Senior years.

ASTRONOMY.—This study is taken up as an elective during the second term of the Junior year. There are three exercises a week, and visits to the observatory help to make the work interesting as well as profitable.

CHEMISTRY.—This study includes a complete course of lectures in Sophomore year upon general inorganic chemistry, in which the principles of the science are fully covered. These are illustrated by experiments, and are sufficiently extended to enable a student who desires to pursue the subject further to take analytical chemistry as an elective in the second term of the Sophomore year. The text-book used in connection with the lectures is Remsen's *Inorganic Chemistry*. There is also a course of experimental chemistry in the laboratory of six hours per week.

PHYSICS.—The complete and thorough course in this subject which is given to students in the School of Technology is offered as an elective in the classical course and is required as a part of the other literary courses. It extends over a year and a half, and covers the topics of Mechanics, Light, Heat, Sound, Electricity and Magnetism. The subject is presented in lectures, supplemented with recitations and laboratory practice.

GEOLOGY.—In the second term of the Senior year a course of lectures is given in connection with Le Conte's text-book. The general principles of the science are explained, and the theories of the formation and stratification of rocks, the successive periods of the development of the earth's crust, the extinct forms of life and similar questions are treated.

PHYSIOLOGY AND HYGIENE.—These subjects are taught in a course of lectures during the Freshman year.

HISTORY.—The study of history begins with a course in the history and antiquities of Greece and Rome. [See the Departments of Greek and Latin.] This is followed by the study of an outline of universal history (with textbook), and this by a fuller study of the political history of recent times, especially of that of England and France. During the Senior year there is a course of lectures upon American Political and Industrial History.

POLITICS.—Study of the Federal, State, and Municipal Governments. Comparisons of the politics of Germany, England, and the United States.

ECONOMICS.—The courses at present given in this department are as follows :

A. *Elementary Economics*.—Description of Modern Business Organization. Analysis of the Concepts of Wealth, Capital, Value, etc. Cannan: *Elementary Political Economy*.

B. *Economic Problems*.—Money, Trusts, Protection and Free Trade, Corporations, Trades Unions, Socialism, Anarchism.

LOGIC.—Junior Class, first term, two hours weekly. Text-book, Prof. Jevons' "Lessons in Logic," supplemented by occasional lectures and by references to more extended logical treatises, such as those of J. S. Mill, Sir William Hamilton, Archbishop Thompson, Baynes' *Port Royal Logic*, etc.

MENTAL AND MORAL PHILOSOPHY.—The work in this department will be conducted chiefly by lectures, interrupted by occasional examinations. The courses at present are the following :

Outlines of Physiological Psychology.—Junior Class, second term. These lectures are founded principally on Wundt's lectures on the same subject, Wundt's *Grundzüge der Physiologischen Psychologie*, James' *Psychology*, Bald-

win's Handbook, Ladd's Elements of Physiological Psychology, Lotze's "Medicinishe Psychologie," Ranke's "Der Mensch," Sully's Outlines of Psychology, Carpenter's Mental Physiology, Maudsley's Physiology and Pathology of the Mind, Bain's Mind and Body, etc., with references to the classical works of Weber, Fechner, and Helmholtz.

The History of Philosophy.—Senior Class, both terms. First Term, Ancient and Medieval Philosophy. Second term, Modern Philosophy. These lectures will include a statement of the conception and problems of philosophy, a brief sketch of the great ethnical religions, and of the history of Oriental philosophy. The philosophy of the Greeks will be treated in detail, with illustrations from the writings of the philosophers.

The history of medieval philosophy will be prefaced by a short description of the philosophical ideas underlying Christianity, and it will contain an account of the more important Church Fathers and Schoolmen.

The history of modern philosophy will begin by tracing the effect on philosophical thought of the ideas contributed by the Renaissance and by the Reformation. From Lord Bacon on, a detailed history of the great modern philosophical systems will be given, which will be continued to those of our own times, including that of Mr. Spencer.

ANTHROPOLOGY.—Senior Class, both terms. These lectures aim at laying the foundation of a scientific study of Man. They include the rudiments of anthropometry and craniology. The earlier lectures give an account of the development, structure, and life of the human body; while the later lectures endeavor to describe the salient peculiarities of existing and prehistoric races of men.

They are based, for the most part, on the works of Bischoff, Broca, Darwin, Hartmann, Haeckel, Huxley, Quételet, Ranke, Virchow, etc.

CHRISTIAN EVIDENCES.—Senior Class, second term. Lectures on Christian evidences, which will endeavor to

treat of the subject both from the side of natural science and from that of biblical criticism.

No complete course in Ethics has as yet been established, but the history of ethics is included in the history of philosophy.

THE COURSE IN SCIENCE AND LETTERS

substitutes the following for the Latin and Greek :

DRAWING.—In the first term of the Freshman year the student is instructed in elementary projections, shading, and lettering.

CHEMISTRY.—In addition to the course in general chemistry described above, three exercises a week in qualitative analysis are taken in the second term of the Freshman year.

MINERALOGY.—Instruction in mineralogy is given to the students in the Course of Science and Letters throughout the Junior year. In the first term they attend a course of lectures on crystallography, followed by a series of practical exercises in the determination of crystalline forms by the aid of models and natural crystals.

In the second term a course on the physical properties of minerals and on descriptive mineralogy, with the use of E. S. Dana's Text-Book of Mineralogy, is followed by practical exercises in the determination of minerals.

GEOLOGY.—The study of lithology is pursued in the first term of the Senior year, with laboratory practice, Williams' Lithology being used as the text-book. During the next term the course given above is taken with the Classical and Latin-Scientific students.

THE CLASSICAL COURSE.

FRESHMAN CLASS.

FIRST TERM.

Mathematics.—Solid geometry. (3) Plane trigonometry. (1)

Greek.—Homer: *Odyssey*. Prosody. (4)

Latin.—Cicero: *De Senectute* and *De Amicitia*. Livy begun. Prose composition. (4)

English.—Rhetoric. (2) Lecture. (1) Essays.

Physiology and Health.—Lectures. (1)

SECOND TERM.

Mathematics.—Plane and spherical trigonometry and mensuration. Use of logarithmic tables. (2) Analytical geometry. (3)

Greek.—Xenophon: *Œconomicus*. (3)

Latin.—Livy completed. Horace: *Odes* and *Epodes*. Composition and prosody. (4)

History.—History of Greece. (2) History of Rome. (1) Roman antiquities. (1)

English.—History of the English language. (2) Essays.

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Algebra. (3)

Chemistry.—Lectures. Remsen's *Inorganic Chemistry*. (2) Laboratory. (2)

French.—Whitney's *Practical French Grammar*. Super's *French Reader*. (2) Or *German*.—Brandt's *Grammar*. Lodeman's *Manual of Exercises*. Buchheim's *Reader*. (2)

Greek.—Herodotus. (3)

Latin.—Horace: *Satires* and *Epistles*. Composition. (3)

History.—History of Rome. (1)

English.—English literature. (2) Essays.

SECOND TERM.

REQUIRED.

French.—Grammar and reader (continued). (2) Or *German*.—Grammar, exercises, reader (continued). (2)

History.—Weber's *Outlines of Universal History*. (2)

Greek.—Euripides: *Medea*. (3)

Latin.—Tacitus: Agricola, Germania, and Annals, or Quintilian: Book X. Composition. (3) Antiquities.

English.—English prose literature. (2) Essays.

ELECTIVE.

(At least four hours per week to be selected.)

Greek.—Demosthenes: De Corona. (2)

Latin.—Plautus. (2)

French.—Grammar and reader. (2)

German.—Grammar and reader. (2)

Physics.—Mechanics. (3)

Projection Drawing.—Descriptive geometry and isometric drawing. Tracings and drawings of structures. (4)

Drawing and Machine Design.—Tracings and blue prints. Sketches and working drawings of machine pieces. Interpretation of machine drawing by isometric sketches. General views from given details. Sections of stub ends and valve passages. Intersection of boiler flues. Empirical proportioning of machine parts. (4)

Chemistry.—Lectures and laboratory practice. Douglas and Prescott's Qualitative Analysis. (5)

Drawing.—Tracings and blue prints. Sections of simple construction. Intersection of spheres, cones, cylinders, etc., illustrated from examples of mining and metallurgical plant. (4)

JUNIOR CLASS.

FIRST TERM.

REQUIRED.

History.—Wilhelm Müller's Political History of Recent Times, and lectures. (2)

Philosophy.—Jevons's Lessons in Logic. (2)

English.—English and American Orators. (1)

French.—Grammar. George Sand: La Mare au Diable. Theuriet: Bigarreau. (2) Or *German*.—Grammar. Beresford-Webb: German Historical Reading Book. (2)

ELECTIVE.

(*At least eight hours per week to be selected.*)

English.—Anglo-Saxon. (2)

Greek.—Sophocles: *Antigone*. Antiquities. (3)

Latin.—Letters of Cicero and Pliny. (3)

Mathematics.—Elementary mechanics; calculus begun.

(5)

Pedagogics.—Elementary course. (2)

Physics.—Heat, electricity and magnetism. Lectures and recitations. (3) Mechanics, heat. Laboratory. (1)

Crystallography.—Lectures, with practical exercises in the determination of crystals. (2)

Toxicology.—Lectures. (2)

SECOND TERM.

REQUIRED.

History.—American Political and Industrial History. (2)

Philosophy.—Lectures on the outlines of physiological psychology. (2)

English.—British Essayists. (1)

French.—Dictation. Compositions. Short stories by François Coppée and Guy de Maupassant. Taine: *Les Origines de la France contemporaine*. Mérimée: *Colomba*. (2) Or *German*.—Jageman's *Prose Composition*. Dictation. Goethe: *Hermann und Dorothea*. Freytag: *Aus dem Staate Friedrichs des Grossen*. (2)

ELECTIVE.

(*At least eight hours to be selected.*)

English.—Philology of the English tongue. (2)

Greek.—Aristophanes: *Clouds*. Æschylus: *Prometheus*. (3)

Latin.—Persius, Plautus and Terence. History of Roman literature. (3)

Mathematics.—Differential and integral calculus, completed. Analytical mechanics. (5)

Astronomy.—Descriptive astronomy. (3)

Physics.—Electricity and magnetism, light, sound. (3)

Mineralogy.—Descriptive mineralogy, with practical exercises in the determination of minerals. E. S. Dana. (3)

Blow-Pipe Analysis.—Lectures, with practice. Plattner, Brush, or Nason and Chandler. (1)

SENIOR CLASS.

FIRST TERM.

REQUIRED.

Politics.—Study of governments. (2)

Economics.—Elementary economics. (1)

Philosophy.—Lectures on the history of ancient and medieval philosophy. (2)

French.—Composition. Dictation. Readings in Corneille, Racine, Molière, Victor Hugo, Alfred de Musset, and contemporary authors. Lectures on French literature. (2) Or *German*.—Grammar. Readings in Lessing, Herder, Goethe, Schiller, etc., and contemporary authors. Compositions. Lectures on German literature. (2) Conversation class in both languages optional throughout the year.

ELECTIVE.

(At least eight hours to be selected.)

English.—Chaucer and his contemporaries. (2)

Greek.—Plato: Phædrus. Greek philosophy. (2)

Latin.—Lucretius, with lectures. Roman literature. (2)

Bibliography. (2)

Astronomy.—Practical astronomy; observatory work. (2)

Mathematics.—Theory of errors and least squares, or differential equations. (2)

Crystallography.—Lectures, with practical exercises in the determination of crystals. (2)

Mechanics of Machinery.—Herrmann-Smith. Graphical Statics of Mechanisms. (2)

Strength of Materials.—Elasticity and strength of wood, stone, and metals. Theory of beams, columns, and shafts. Reportson experimental tests. (4)

Quantitative Analysis.—Fresenius' Quantitative Analysis, and Conference. (6)

SECOND TERM.

REQUIRED.

Economics.—Economic problems. (1)

Philosophy.—Lectures on the history of modern philosophy. (2)

Christian Evidences.—Lectures. (1)

French.—Readings. Compositions. Lectures in French on modern French authors. (2) Or *German*.—Readings. Compositions. Lectures in German on modern German authors. (2)

Geology.—Lectures. LeConte. (3)

ELECTIVE.

(At least eight hours to be selected.)

English.—Study of Verse. (2)

Greek.—Pindar: selected odes. Greek literature. (2)

Latin.—Cicero: De Officiis. Lectures on the history of classical philology. (2)

Mineralogy.—Descriptive mineralogy, with practical exercises in the determination of minerals: E. S. Dana. (3)

Steam Engine.—Holmes' Steam Engine. (4)

Quantitative Analysis.—Fresenius' Quantitative Analysis, and Conference. (6)

Hydraulics.—Hydrostatics. Flow of water in pipes and channels. Hydraulic motors. (3)

Preparation of Thesis.

THE LATIN-SCIENTIFIC COURSE.

The Latin-Scientific Course, leading to the degree of Bachelor of Science (B.S.), is based on Latin without Greek.

FRESHMAN CLASS.

FIRST TERM.

Mathematics.—Solid geometry. (3) Plane trigonometry. (1)

German.—Review of Grammar, especially as to syntax. Jageman's Prose Composition. Short stories by different modern authors. (3)

Latin.—Cicero : De Senectute and De Amicitia. Livy begun. Prose composition. (4)

English.—Rhetoric. (2) Lecture. (1) Essays.

Physiology and Health.—Lectures. (1)

SECOND TERM.

Mathematics.—Plane and spherical trigonometry and mensuration. Use of logarithmic tables. (2) Analytical geometry. (3)

German.—Prose composition. Beresford-Webb : German Historical Reading Book. Freytag : Aus dem Staate Friedrichs des Grossen. Dictation. (3)

History.—History of Greece. (2) History of Rome. (1) Roman antiquities. (1)

Latin.—Livy (completed). Horace : Odes and Epodes. Composition and prosody. (4)

English.—History of the English language. (2) Essays.

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Algebra. (3)

Chemistry.—Lectures. Remsen's Inorganic Chemistry. (2) Laboratory. (2)

French.—Whitney's Practical French Grammar. Super's Reader. (2)

German.—Readings in Lessing, Herder, Goethe, Schiller, and contemporary authors. Dictation. Compositions. (2) Conversation class in German optional throughout the year.

History.—History of Rome. (1)

Latin.—Horace : Satires and Epistles. Composition. (3)

English.—English literature. (2) Essays.

SECOND TERM.

French.—Grammar. Reader (continued). (2)

German.—Readings (continued). Dictation. Compositions. (2)

- History*.—Weber's Outlines of Universal History. (2)
Latin.—Tacitus: Agricola, Germania, and Annals, or Quintilian: Book X. Composition. (3) Antiquities.
English.—English prose literature. (2) Essays.
Chemistry.—Lectures and laboratory practice. Douglas and Prescott's Qualitative Analysis. (4)

JUNIOR CLASS.

FIRST TERM.

- History*.—Wilhelm Müller's Political History of Recent Times, and lectures. (2)
Philosophy.—Jevons's Lessons in Logic. (2)
Pedagogics.—Elementary course. (2)
English.—Anglo-Saxon. (2) English and American Orators. (1)
French.—Grammar. George Sand: La Mare au Diable. Theuriet: Bigarreau. (2)
German.—Readings (continued). Composition. Lectures on German literature. (2)
Latin.—Letters of Cicero and Pliny. (3)

SECOND TERM.

- History*.—American Political and Industrial History. (2)
Philosophy.—Lectures on the outlines of physiological psychology. (2)
English.—Philology of the English tongue. (2) British Essayists. (1)
Astronomy.—Descriptive astronomy. (3)
Physics.—Mechanics. (3)
French.—Prose composition. Labiche et Martin: Le Voyage de M. Perrichon. Short stories by François Coppée and Guy de Maupassant. Dictation. (2)
Latin.—Persius, Plautus and Terence. History of Roman literature. (3)
 NOTE.—Calculus may be substituted for Latin throughout the Junior year.

SENIOR CLASS.

FIRST TERM.

Politics.—Study of governments. (2)

Economics.—Elementary economics. (1)

Philosophy.—Lectures on the history of ancient and medieval philosophy. (2)

Physics.—Heat, electricity and magnetism: lectures and recitations. (3) Mechanics, heat: laboratory. (1)

French.—Readings in Corneille, Racine, Molière, etc., and contemporary authors. Lectures on French literature. (2)

English.—Chaucer and his contemporaries. (2)

Latin.—Lucretius, with lectures. Roman literature. (2)

Bibliography. (2)

SECOND TERM.

Economics.—Economic problems. (1)

Philosophy.—Lectures on the history of modern philosophy. (2)

Christian Evidences.—Lectures. (1)

Geology.—Lectures. Le Conte. (3)

Physics.—Electricity and magnetism, light, sound. (3)

English.—Study of Verse. (2)

Latin.—Cicero: De Officiis. Lectures on the history of classical philology. (2)

French.—Readings (continued). Compositions. Lectures in French on modern French authors. (2)

Preparation of Thesis.

COURSE IN SCIENCE AND LETTERS.

The Course in Science and Letters, leading to the Degree of Bachelor of Science (B.S.), is designed for those who wish to pursue both scientific and literary studies without Latin and Greek. These being omitted, extended instruction is given in French and German, History, General Literature, Mathematics, and General Science.

FRESHMAN CLASS.

FIRST TERM.

Mathematics.—Solid geometry. (3) Plane trigonometry. (1)

Chemistry.—Lectures. Remsen's Inorganic Chemistry. (2) Laboratory. (2)

German.—Review of Grammar, especially as to syntax. Jageman's Prose Composition. Short stories by different modern authors. (3)

Drawing.—Freehand sketching and lettering. (2)

English.—Rhetoric. (2) Lectures. (1) Essays.

Physiology and Health.—Lectures. (1)

SECOND TERM.

Mathematics.—Analytical geometry. (3) Plane and spherical trigonometry and mensuration. Use of logarithmic tables. (2)

Chemistry.—Lectures and laboratory practice. Douglas and Prescott's Qualitative Analysis. (3)

Physics.—Mechanics. (3)

German.—Prose composition. Beresford-Webb: German Historical Reading Book. Freytag: Aus dem Staate Friedrichs des Grossen. (3)

English.—History of the English language. (2) Essays.

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Algebra. (3)

Physics.—Heat, electricity and magnetism. Lectures and recitations. (3). Mechanics, heat. Laboratory. (1).

Chemistry.—Fresenius's Quantitative Analysis. (3)

French.—Whitney's Practical French Grammar. Super's Reader. (2)

German.—Readings in Lessing, Herder, Goethe, Schiller, and contemporary authors. Dictation. Compositions. (2) Conversation class in German optional throughout the year.

English.—English literature. (2) Essays.

SECOND TERM.

Physics.—Electricity, magnetism, light, sound. (3)

Steam Engine.—Holmes's Steam Engine. (4)

French.—Grammar. Readings (continued). (2)

German.—Lessing, Herder, Goethe, Schiller, Heine, etc. Compositions. (2)

History.—Weber's Outlines of Universal History. (2)

History of Greece. (2) History of Rome. (1)

English.—English prose literature. (2) Essays.

JUNIOR CLASS.

FIRST TERM.

History.—Wilhelm Müller's Political History of Recent Times, and lectures. (2) History of Rome. (1)

Philosophy.—Jevons's Lessons in Logic. (2)

Pedagogics.—Elementary course. (2)

English.—Anglo-Saxon. (2) English and American Orators. (1)

French.—Grammar. George Sand: *La Mare au Diable*. Theuriet: *Bigarreau*. (2)

German.—Readings (continued). Compositions. Lectures on German literature. (2)

Crystallography.—Lectures, with practical exercises in the determination of crystals. (2)

SECOND TERM.

History.—American Political and Industrial History. (2)

Philosophy.—Lectures on the outlines of physiological psychology. (2)

English.—Philology of the English tongue. (2) British Essayists. (1)

French.—Prose Composition. Labiche et Martin: *Le Voyage de M. Perichon*. Short stories by François Coppée and Guy de Maupassant. Dictation. (2)

Astronomy.—Descriptive astronomy. (3)

Mineralogy.—Descriptive mineralogy, with practical exercises in the determination of minerals. (3)

SENIOR CLASS.

FIRST TERM.

Politics.—Study of governments. (2)

Economics.—Elementary economics. (1)

Bibliography. (2)

Philosophy.—Lectures on the history of ancient and medieval philosophy. (2)

English.—Chaucer and his contemporaries. (2)

French.—Readings in Corneille, Racine, Molière, etc., and contemporary authors. Compositions. Lectures on French literature. (2)

Astronomy.—Practical astronomy. (2)

Geology.—Williams' Lithology, and laboratory practice. (2)

SECOND TERM.

Economics.—Economic problems. (1)

Philosophy.—Lectures on the history of modern philosophy. (2)

Christian Evidences.—Lectures. (1)

English.—Study of Verse. (2)

French.—Readings (continued). Compositions. Lectures in French on modern French authors. (2)

Geology.—Historic and dynamic geology. LeConte. (3)

Preparation of Thesis. (4)

THE SCHOOL OF TECHNOLOGY.

This school includes six distinct courses :

- I. The Course in Civil Engineering.
- II. The Course in Mechanical Engineering.
- III. The Course in Metallurgy.
- IV. The Course in Mining.
- V. The Course in Electrical Engineering.
- VI. The Course in Chemistry.

These have the same curriculum of studies for the first term of the Freshman year. After the first term the student follows the program of the course which he has selected.

FRESHMAN CLASS.

FIRST TERM.

Mathematics.—Algebra. (3) Plane trigonometry. (1)

Chemistry.—Lectures. Remsen's Inorganic Chemistry. (2) Laboratory. (2)

German.—Review of Grammar, especially as to syntax. Jageman's Prose Composition. Short stories by different authors. (3) Or *French*.—Review of Grammar, especially as to syntax. George Sand: *La Mare, au Diable*. Theuriet: *Bigarreau*. Short stories by François Coppée and Guy de Maupassant. (3)

Drawing.—Free-hand sketching and lettering. (2)

English.—Rhetoric. (2) Lecture. (1) Essays.

Physiology and Health.—Lectures. (1)

THE COURSE IN CIVIL ENGINEERING.

The special technical studies in this course may be grouped under the heads of Surveying, Applied Mechanics, Road and Railroad Construction, Bridge Design, and Hydraulic and Sanitary Engineering.

The work in Surveying extends over four terms and embraces land surveying, leveling, topography, triangulation, railroad reconnaissance and location, hydrography, and the elements of geodesy. A large equipment of transits, levels, and other surveying tools affords students the opportunity of becoming familiar with the instruments of different manufacturers. Much time is devoted to practice in the field and drafting room, each student being required to become proficient in the use of instruments, in taking field notes, and in map-drawing. Particular attention is paid to the execution of topographical surveys and maps by the best modern methods. Railroad maps and profiles are made from actual field location. During the Junior year there is done secondary triangulation work of a high order of precision.

The work in Applied Mechanics comprises the strength and elasticity of materials, the theory of the equilibrium of arches, roofs, and bridges, that part of the mechanics of machinery which relates to locomotives and hoisting machines, and the theory of hydraulics and hydraulic motors. Here the theoretical principles are illustrated by examples and problems taken, as far as possible, from actual engineering practice. Tests and experiments on materials are made in the testing laboratory.

The course in Construction familiarizes the student with the qualities of materials used in engineering structures, with methods of preservation and testing, with masonry and foundations, and with the building and maintenance of roads and railroads. All the standard tests for hydraulic cements and mortars are made by each student.

The course in Bridge Design is preceded by the theory of computation of stresses by both analytical and graphic methods. Starting with the specifications for a first-class iron highway or railroad bridge, each student then makes the full computations, designs, working drawings, and bills of material for a plate girder, a lattice girder, and a pin-connected truss bridge. The weight of the designed bridge is finally determined and compared with the dead load

assumed for the calculations. The drawings are made and dimensioned in the same manner as in the drafting-office of a bridge company. In connection with this course visits of inspection to bridges in the vicinity are regularly made.

The work in Hydraulic and Sanitary Engineering includes the study of systems of water supply, the collection, purification, and distribution of water, the combined and the separate systems of sewerage, the methods for the disposal of sewage, and the best practice for the drainage of houses. There is also a course on the flow of water in pipes and channels, together with the discussion of hydraulic motors.

Besides these special studies there is a course in astronomy, which includes practical work in the observatory. The study of English, and of French or German, is continued, and instruction is given during four terms in crystallography, mineralogy, lithology, and geology.

The student who completes all the studies of this course will receive the degree of Civil Engineer (C.E.).

Opportunities for graduate study are offered by this department in the following subjects: Theory of Elasticity and Strength of Materials, Bridge Engineering, Railroad Engineering, Hydraulic and Sanitary Engineering, Geodesy and the Figure of the Earth.

FRESHMAN CLASS.

FIRST TERM.

See page 51.

SECOND TERM.

Mathematics.—Analytical geometry. (3) Plane and spherical trigonometry and mensuration. Use of logarithmic tables. (2)

Physics—Mechanics. (3)

Projection Drawing.—Descriptive geometry and isometric drawing. Tracings and drawings of structures. (4)

German.—Dictation. Compositions. Beresford-Webb : German Historical Reading Book. Freytag : Aus dem Staate Friedrichs des Grossen. Readings from Lessing, Schiller, Goethe. (3) Or *French*.—Dictation. Compositions. Mérimée : Colomba. Halévy : L'Abbé Constantin. Daudet : Choix de Contes. Molière : L'Avare. Super : Readings from French History. Readings from Victor Hugo, Balzac, Dumas. (3) Conversation class in both languages optional throughout the year.

English.—History of the English language. (2) Essays.

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Elementary mechanics. Calculus begun. (5)

Physics.—Heat, electricity and magnetism. Lectures and recitations. (3) Mechanics, heat. Laboratory. (1)

Architectural Drawing.—Plans of piers and arches. Problems in stone cutting. Use of water colors. (3)

Construction.—Materials, masonry, and carpentry. Roads, streets, and pavements. Sketches of structures. (3)

English.—English literature. (2) Essays.

SECOND TERM.

Mathematics.—Differential and integral calculus completed. Analytical mechanics. (5)

Land Surveying.—Theory and use of compass, level, and transit. Surveys and maps of farms. Leveling. (4)

Physics.—Electricity and magnetism, light, sound. (3)

Steam Engine.—Holmes's Steam Engine. (3)

English.—English prose literature. (2) Essays.

SUMMER SCHOOL.

Topographic Surveying.—Field work with transit and stadia, and with plane table. Topographic maps.

JUNIOR CLASS.

FIRST TERM.

Mathematics.—Theory of errors and least squares. (2)

Strength of Materials.—Elasticity and strength of wood, stone, and metals. Theory of beams, columns, and shafts. Work in the testing laboratory. (4)

Construction.—Foundations, arches, walls, dams, and bridges. Visits of inspection. (4)

Geodetic Surveying.—Field work in precise triangulation. Use of solar transit. Lectures on geodesy. (3)

Crystallography.—Lectures, with practical exercises in the determination of crystals. (2)

Economics.—Elementary course. (1)

English.—English and American Orators. (1)

SECOND TERM.

Astronomy.—Descriptive astronomy. (3)

Railroad Surveying.—Theory of railroad curves. Railroad reconnaissance and location. Survey of a line, with profile, map, and estimate of cost. (4)

Roofs and Bridges.—Theory and calculations of stresses in roof and bridge trusses. (5)

Mineralogy.—Descriptive mineralogy, with practical exercises in the determination of minerals. (3)

English.—British Essayists. (1)

Christian Evidences.—(1)

SENIOR CLASS.

FIRST TERM.

Astronomy.—Practical astronomy. Observatory work. (2)

Graphic Statics.—Analysis of roof and bridge trusses. (2)

Bridges.—Design of plate girders, riveted bridges, and pin-connected trusses, with working drawings. (6)

Hydraulics.—Hydrostatics. Efflux of water from orifi-

ces and flow in pipes and rivers. Hydraulic motors. (3)

Mechanics of Machinery.—Pile drivers, cranes, and elevators. The mechanics of the locomotive. (2)

Geology.—Williams' Lithology, with practical exercises in determining rocks. (2)

SECOND TERM.

Bridges.—Theory of cantilever, draw, continuous, suspension, and arched structures. (3)

Sanitary Engineering.—Collection, purification, and distribution of water. Systems of water supply and sewerage. Disposal of sewage. House drainage. Irrigation engineering. (4)

Contracts and Specifications.—Business practice and law. (2)

Electricity.—Equipment and operation of electric railways. Measurement of power. (2)

Geology.—Historic and dynamic. Le Conte. (3)

Preparation of Thesis. (3)

THE COURSE IN MECHANICAL ENGINEERING.

The object of this course is the study of the Science of Machines. The principal subjects taught are: the nature, equivalence, and analysis of mechanisms, the mechanics or theory of the principal classes or types of machinery, mechanical technology, the principles and practice of machine design, and the measurement of power.

Through the kindness of the officers of the Lehigh Valley Railroad Company and of the officers of the Bethlehem Iron Company, the students of the Lehigh University have access to all the shops of the Railroad from New York to Buffalo and to all the departments and shops of the immense Iron Works, in which the iron and steel industry has reached its highest development in this country. In this manufacture may be seen every process, from the smelting of the ore to the finishing of great shafts, cranks, and

armor plates for the navies of the world, and to the finishing of 16-inch breech-loading rifled guns for the War Department of the United States. These extraordinary privileges are thoroughly appreciated by the Mechanical Engineering Department and are utilized in every part of its work.

The earliest shop visits are for the purpose of acquainting beginners with machine parts and the usual tools of a shop. These visits are a part of the work of a Summer School, lasting four weeks, which is held at the close of the second term of Freshman year. A classified and numbered list of some three hundred and sixty items is given to each student, who makes a written report on them with free-hand sketches containing the leading dimensions. The class is divided into sections, which are separately taken into the shops by the instructor, who then indicates the pieces that are to be examined and gives all necessary explanations. Thus at the very beginning of the course the student is brought into direct contact with the elements of machinery and the common resources of the shop, becomes familiar with technical terms, and is in a position to understand and appreciate subsequent instruction.

In this same Summer School the students of Mechanical Engineering are also given a course in the examination of the mechanical construction of electrical instruments and machinery and in the inspection of their use and operation in electrical plants. This is regarded as a very desirable preliminary to the study of Physics and to the special course in Electrical Engineering which they pursue later on.

That the students may obtain the practical engineering data which they will most need when beginning their work as mechanical engineers they are next required to pursue a course of shop instruction (Mechanical Technology), which does not necessarily involve manual labor and manipulation of tools, but is principally devoted to familiarizing them with those points in pattern-making, moulding,

forging, fitting and finishing, which they need to know as designers of machinery. Particular attention is, therefore, directed to the forms and sizes of machine parts that can be readily constructed in the various workshops; to the time that it takes to perform, and the order of, the various operations; to the dimensions most needed by workmen, and to the various devices for increasing the accuracy of the work, durability of the parts, and convenience of manipulation.

That the students may learn to observe carefully and be trained to think and observe for themselves in these matters, there is required of them a full description of the various processes, operations, and tools involved in the production of each one of a series of properly graded examples of patterns, castings, forgings, and finished pieces, which are not under construction in the shops at the time and the drawings for which have been given to them on entering the shops. The student's work is directed not only by these drawings and by the printed program given him at the start, but also personally by a teacher, who accompanies him in each shop, gives necessary explanations, and tests the extent and accuracy of his knowledge. Three teachers are engaged in this work, one for each shop and section. Hereafter this study of Mechanical Technology will be carried on in a Summer School lasting four weeks, which will be held at the end of the Sophomore year.

During the course there are frequent visits of inspection to the Bethlehem Iron Company, to the L. V. R. R. shops at Easton, and to other engineering works both in and out of town, with special reference to such subjects as prime movers, machinery for lifting, handling, and transporting, and machinery for changing the form and size of materials. It is intended that each of these excursions shall have some definite purpose in view which must be fully reported by the students. These visits are also made the occasion for continued practice in the free-hand sketching of machinery.

The instruction in Machine Design begins with the sec-

ond term of the Freshman year and is continued throughout the course. At first tracings and blue prints of good examples of drawings of machinery are made. A thorough drill in projection drawing follows; in this work free-hand sketches are first made, and measurements taken, of machine pieces; these sketches are then converted into full-size working drawings. Then there is considerable practice in the interpretation of such drawings, and general views of lathes, planers, drills, and shapers are made from the drawings of the details. This is followed by difficult projections and intersections and exercises in the empirical proportioning of machine parts. Both empirical and rational formulas are used to determine the dimensions of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers and connecting rods, the data being given as they would arise in practice and the drawings made full size. During the Junior year the class takes up the design of a high-speed steam engine, every dimension being determined by the students and complete drawings made. During the Senior year the students undertake the calculations, estimates, and working drawings involved in the design of a simple but complete machine, each student being engaged upon a different machine. In the case of these machines and of the engine the general plan of arrangement will be given to the students in the form of rough sketches, photographs, or woodcuts. In the last term the students are expected to make original designs for simple machinery, whose object has been fully explained. Throughout the course the work in the draughting-room is carried on as nearly as possible like that of an engineering establishment, and special attention is paid to methods of expediting the work of calculation by means of simple formulas, tables, and diagrams.

The students in Mechanical Engineering are given a special course in Electrical Engineering after they have finished the regular and general course in Physics. The object is to impart a clear conception of electrical units and

a working knowledge of resistance, impedance, inductance, reactance, capacity, and the magnetism of iron, and the magnetic circuit as used in the construction of electrical machinery. Attention is then directed to the theory and calculation of direct current dynamos, to the study of variable and alternating current phenomena, and to the theory of the alternating current transformer. Practical problems are given in these subjects to show their application. The laboratory work which accompanies this special course involves tests of resistance, insulation, consumption of energy, and efficiency. Instruction is also given in locating and remedying the common faults of dynamos and motors.

The course in measurement of power involves much practice with the indicator. Cards are taken from the many types of engines running in the shops and power houses of the vicinity, and thorough drill is given in working up and interpreting these cards. There are also experiments with dynamometers of the friction-brake, belt, float, and cradle varieties. The work in boiler testing usually includes a test of the boilers of the University, a combined engine and boiler test at one of the silk mills, and a test of the boilers and pumping engine of the Water Works. With the engines belonging to the University tests of governor action are made. In addition there are experiments with calorimeters, duty tests of injectors and small pumps, and practice in gas and coal analysis.

All the students in this course are required to study both German and French.

The graduates in this course will receive the degree of Mechanical Engineer (M.E.).

FRESHMAN CLASS.

FIRST TERM.

See page 51.

SECOND TERM.

Mathematics.—Analytical geometry. (3) Plane and

spherical trigonometry and mensuration. Use of logarithmic tables. (2)

Physics.—Mechanics. (3)

Drawing and Machine Design.—Tracings and blue prints. Sketches and working drawings of machine pieces. Interpretation of machine drawing by isometric sketches. General views from given details. Sections of stub ends and valve passages. Intersection of boiler flues. Empirical proportioning of machine parts. (4)

German.—Dictation. Compositions. Beresford-Webb: German Historical Reading Book. Freytag: Aus dem Staate Friedrichs des Grossen. Readings from Lessing, Schiller, Goethe. (3) Or *French*.—Dictation. Compositions. Mérimée: Colomba. Halévy: L'abbé Constantin. Daudet: Choix de Contes. Molière: L'Avare. Super: Readings from French History. Readings from Victor Hugo, Balzac, Dumas. (3) - Conversation class in both languages optional throughout the year.

English.—History of the English language. (2) Essays.

SUMMER SCHOOL.*

Visits of Inspection.—Examination and sketching of machine parts and of electrical apparatus and machinery.

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Elementary mechanics. Calculus begun. (5)

Physics.—Heat, electricity and magnetism. Lectures and recitations. (3) Mechanics, heat. Laboratory. (1)

Machine Design.—Proportioning of such machine parts as come under the head of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers, and connecting rods. (3)

* Optional in 1898.

Boilers.—Peabody and Miller. Strength, construction, and wear and tear of boilers. (1)

French.—Whitney's Practical French Grammar. Super's Reader. (2) Or *German.*—Joynes-Meissner's Grammar. Buchheim's Reader. (2)

English.—English literature. (2) Essays.

SECOND TERM.

Mathematics.—Differential and integral calculus, completed. Analytical mechanics. (5)

Physics.—Electricity and magnetism, light, sound. Lectures and recitations. (3) Laboratory. (1)

Steam Engine.—Holmes' Steam Engine. (4)

French.—Grammar and Reader (continued). (2) Or *German.*—Grammar and Reader (continued). Short stories by different modern authors. (2)

English.—English prose literature. (2) Essays.

SUMMER SCHOOL.

Mechanical Technology.—Shop instruction. Examination of the processes and appliances involved in pattern-making, moulding, forging, fitting, and finishing.

JUNIOR CLASS.

FIRST TERM.

Mathematics.—Differential equations. (2)

Strength of Materials.—Elasticity and strength of wood, stone, and metals. Theory of beams, columns, and shafts. Reports on experimental tests. (4)

Mechanics of Machinery.—Herrmann-Smith. Graphical Statics of Mechanisms. (2)

Electro-technology.—Theory of magnetism. Direct and alternating currents. Dynamos and motors. Electric light and power. (5)

French.—Advanced grammar. George Sand: *La Mare au Diable*. Dumas: *Pauline*. (2) Or *German.*—Advanced grammar. Short stories by different modern authors. (2)

Economics.—Elementary economics. (1)

English.—English and American Orators. (1)

SECOND TERM.

Metallurgy.—Metallurgical processes. Furnaces. Refractory building materials. Combustion. Natural and artificial fuels. Metallurgy of iron. (5)

Machine Design.—Calculations and working drawings for a high-speed steam engine. (4)

Machinery of Transmission.—Weisbach-Herrmann. (3)

Dynamo Laboratory.—Testing out. Insulation and conductivity tests. Dynamo and motor tests, and location of faults. (1)

French.—Advanced grammar. Short stories by François Coppée and Guy de Maupassant. Vigny: Le Cachet Rouge. Dictation. (2) Or *German*.—Advanced grammar. Beresford-Webb: German Historical Reading Book. Freytag: Aus dem Staate Friedrichs des Grossen. Dictation. (2)

Economics.—Economic problems. (1)

English.—British Essayists. (1)

SENIOR CLASS.

FIRST TERM.

Thermodynamics.—General principles; application to steam engines and air compressors. (3)

Kinematics of Machinery.—Nature and equivalence of mechanisms. Diagrams of the changes of position, speed, and acceleration in mechanisms. Valve and link motions. (5)

Graphical Statics.—Graphical analysis of roof trusses and girders. (2)

Machine Design.—Calculations and working drawings for hoisting, pumping, and metal-working machinery. (4)

Measurement of Power.—Indicating of steam engines; determination of evaporative efficiency of boilers; dynamometer experiments. (1)

Mechanics of Machinery.—Weisbach-Herrmann. Hoisting machinery, accumulators, cranes, and locomotives. (2)

SECOND TERM.

Mechanics of Machinery.—Weisbach-Herrmann. Pumps, pumping engines, blowing engines, compressors, and fans.

(4)

Machine Design—Original designs. (5)

Hydraulics.—Hydrostatics. Flow of water in pipes and channels. Hydraulic motors. (3)

Measurement of Power.—Indicating of steam engines; determination of evaporative efficiency of boilers; dynamometer experiments. (1)

Christian Evidences.—Lectures. (1)

Preparation of Thesis.

THE COURSES IN MINING ENGINEERING.

These courses aim to fit the student for practical work in either of the branches of mining, metallurgy, metallurgical chemistry, or geology. On account of the great number and scope of the studies necessary to the attainment of the degree of Engineer of Mines (E.M.), which includes that of Metallurgist, five years are required. At the end of the fourth year the student will have completed a course similar to that leading to the scientific degree in other institutions, and will receive the degree of Bachelor of Science (B.S.) in either mining or metallurgy. The following program of subjects and studies shows the requirements for the degree of Engineer of Mines.

MODERN LANGUAGES.—Although the option of studying French or German lies with the student, it may be well to note that the current literature of the subjects taught in these courses is more abundant in the latter language.

DRAWING AND CONSTRUCTION.—The course in mechanical drawing begins with tracings of good examples of machine drawings; then follow the interpretation of such drawings, and the making of general views of machines from detailed sketches, exercises in projection drawing

from the same, and the proportioning of simple tools and machines.

A brief course in descriptive geometry is given, in which the student is grounded in the fundamental principles of the subject. The simpler applications are given in the form of problems, and a number of practical examples are worked out in the drawing room.

Under the charge of an instructor, the students make visits of inspection to mines and metallurgical works, during which they examine and make sketches of portions of the plant, and take notes concerning it. From these sketches and notes they subsequently make working drawings accompanied by written memoirs explanatory of the construction and operation of the plant.

In a later portion of the course the students are required to make original designs for mining and metallurgical plant under given conditions, involving exercise in the adaptation and proportioning of structures, machinery, and apparatus to suit the conditions given.

The field work in mining and geological surveying is followed by map construction from field notes.

CHEMISTRY.—The course in theoretical and applied chemistry extends over three years and includes work in wet and dry assaying of all the important ores and metallurgical products met with in actual practice, combined with the working of stoichiometric problems and the study of chemical philosophy. The practical work is that required for a metallurgical chemist or assayer.

With moderate care the expenses in this department need not exceed \$120.

MINERALOGY.—This subject is divided into two courses. In the first course, after a short exposition of the laws of crystallography and a description of crystalline forms, practical exercises are held in the determination of simple and complex crystals, in which the student is taught to identify the various crystalline forms observed in minerals by the aid of models and of actual crystals, and with the use of

the application goniometer. The second course includes the subjects of physical, descriptive, and determinative mineralogy. As in the first course, the greater part of the time is devoted to practical exercises, which, in this course, have for their object the determination of minerals. Each student is thus enabled to become familiar with the more common minerals by the actual handling of several hundred specimens, with the facility of making such tests as will not injure them. The presence of one or more instructors during each exercise permits the student to make frequent reports of his determinations, and to receive much instruction as to the characteristics of the minerals. The knowledge thus acquired can be supplemented by visits to the museum.

The course in blowpipe analysis may be considered as auxiliary to the practical exercises in determinative mineralogy. In the latter the student is urged to rely chiefly on physical tests; in the former he is required to determine minerals by the aid of the blowpipe.

The mineralogical laboratory offers facilities for an advanced course in crystallography and in physical and microscopic mineralogy to a few students who may receive permission to pursue such a course.

GEOLOGY.—This subject is studied with special reference to the needs of the mining engineer. Within a radius of twenty miles the student meets and becomes acquainted with the rocks of the archæan, the palæozoic, and the mesozoic formations, and makes geological maps from his own field notes, paying attention to the lithological characters of the formations, as they are mainly non-fossiliferous south of the Blue Ridge. An extended practical course in lithology familiarizes the student with the rocks of importance to the mining engineer and enables him to determine them by sight. There are over 2,500 specimens in the collections, embracing nearly all the known species. The course in historic geology is illustrated by a cabinet of typical specimens. The course in economic geology supplements the above work by familiarizing the student with

the geological horizon of all the valuable constituents of the earth's crust and the theories of their formation. As Bethlehem is near the center of the "extra-morainic" drift, exceptional facilities are afforded for the study of pleistocene geology in Eastern Pennsylvania.

APPLIED MECHANICS.—This embraces hydraulics, a study of the steam engine, and the mechanics of machines employed in mining and metallurgy.

SURVEYING.—A course extending over five terms offers practice in land, mine, and geological surveying, leveling, topography, triangulation, railroad reconnaissance and location, and the use of the solar transit. It also includes practical work in drawing and map construction.

Candidates for the degree of B. S. in Mining will be required to take the course of topographical surveying in the Summer School at the end of the Sophomore year. Candidates for the degree of E. M., who have taken the degree of B. S. in Metallurgy, will be required to take the course of topographical surveying in the Summer School at the end of the Senior year. Students in Metallurgy may fulfill this requirement in anticipation by taking this course in the Summer School at the end of either the Sophomore or the Junior year.

METALLURGY.—There are two courses, making, together, about one hundred and forty lectures on this subject, which extend throughout a year. In these the chief object kept in view is a clear presentation of the principles involved in the various metallurgical processes, looked upon as the application to practice of the laws of chemistry, physics, and mechanics. This is followed, in the case of each process, by a description of the more important examples of the plant and of the methods of conducting the process, and by indications concerning its economic features. In order to ensure the student's understanding the fundamental principles of metallurgy, and his becoming so familiar with them as to be able readily to apply them, he is required to solve a series of problems in which these

principles are involved. Many of the problems are such as are likely to present themselves to the metallurgist in his current practice.

The metallurgical laboratory affords opportunity for special investigations in subjects connected with metallurgy to such advanced students as are competent to conduct them.

MINING.—This subject is covered by three courses. The first begins with the application of economic geology to the needs of the engineer, so that he can study and value mining properties, locate appropriately the necessary plant, and calculate the cost of production. It includes the discussion of faults and the means of finding faulted bodies, with practical problems. The subjects of blasting, timbering, and winning deposits are applied to actual cases, as tunnel-driving, etc., and problems from practical data are solved by the students. The second course covers the subjects of underground and surface haulage; loading, unloading, and stocking ores; pumping, ventilation, hygiene, and mining law. A series of problems is given in each of these subjects to cover cases that meet the engineer in ordinary practice. The third course treats of the mechanical preparation of ores by the wet, dry, or magnetic methods, and especially of the preparation of anthracite coal.

The location of the University in the vicinity of the iron works of the Lehigh Valley, and especially of the extensive establishment of the Bethlehem Iron Company, affords unusual facilities for the practical study of iron metallurgy. The processes for the manufacture of spelter and oxide of zinc may be studied at the works of the Lehigh Zinc and Iron Co. The facilities for the practical study of mining and economic geology are not excelled by those of any other institution in the country. The zinc mines at Friedensville, the paint ores of the Marcellus formation, and the brown hematite and slate deposits of the Lehigh Valley are in the immediate vicinity, while within easy reach by rail are the semi-bituminous and anthracite coal fields, the block and fossil iron ores of the

Clinton measures, the iron mines at Cornwall, Pennsylvania, and the iron and zinc mines of New Jersey, together affording examples of nearly all the methods of winning and dressing valuable deposits. Numerous visits of inspection are made in connection with the work of the course, to familiarize the student with metallurgical and mining processes and afford data for practical examples and projects.

THE COURSE IN METALLURGY.

This course is arranged so that the subjects which prepare the student for practice in the field of metallurgy shall be completed at the end of four years, when the graduate will receive the degree of Bachelor of Science in Metallurgy (B.S.). By remaining a year longer, and taking the subjects laid down for the graduate year, the graduate in the course may obtain the degree of Engineer of Mines (E. M.).

FRESHMAN CLASS.

FIRST TERM.

See page 51.

SECOND TERM.

Mathematics.—Analytical geometry. (3) Plane and spherical trigonometry and mensuration. Use of logarithmic tables. (2)

Drawing.—Tracings and blue prints. Sketches and working drawings of machine pieces. Interpretation of drawings by isometric sketches. General views from given details. Sections of simple construction. Intersections of spheres, cones, cylinders, etc., accompanying the study of descriptive geometry and illustrated from examples of mining and metallurgical plant. (4)

Physics—Mechanics. (3)

German.—Dictation. Compositions. Beresford-Webb: German Historical Reading Book. Freytag: Aus dem

Staate Friedrichs des Grossen. Readings from Lessing, Schiller, Goethe. (3) Or *French*.—Dictation. Compositions. Mérimée: Colomba. Halévy: L'abbé Constantin. Daudet: Choix de Contes. Molière: L'Avare. Super: Readings from French History. Readings from Victor Hugo, Balzac, Dumas. (3) Conversation class in both languages optional throughout the year.

English.—History of the English language. (2) Essays.

SUMMER SCHOOL.

Visits of Inspection.—Examination and sketching of machine parts and of electrical apparatus and machinery.

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Elementary mechanics. Calculus begun. (5)

Physics.—Heat, electricity and magnetism. Lectures and recitations. (3) Mechanics, heat. Laboratory. (1)

Drawing.—Flat tinting with water colors. Graphical problems illustrating the direction and extent of throw in faults. Examination and sketching of metallurgical plant in the vicinity. General views and working drawings of the plant examined, accompanied by written descriptions of its construction and operation. (4)

Land Surveying.—Theory and use of level and transit. Field practice and map-drawing. (2)

English.—English literature. (2) Essays.

SECOND TERM.

Mathematics.—Differential and integral calculus, completed. Analytical mechanics. (5)

Physics.—Electricity and magnetism, light, sound. (3)

Chemistry.—Lectures and laboratory practice. Douglas and Prescott's Qualitative Analysis. (5)

Stoichiometry. (2)

English.—English prose literature. (2) Essays.

JUNIOR CLASS.

FIRST TERM.

Strength of Materials.—Elasticity and strength of wood, stone, and metals. Theory of beams, columns, and shafts. Reports on the testing of materials. (4)

Crystallography.—Lectures, with practical exercises in the determination of crystals. (2)

Chemistry.—Fresenius' Quantitative Analysis. (3)
The following analyses are executed by the student :

1. Iron wire (Fe).
2. Potassium Dichromate (Cr_2O_3).
3. Copper ore (Cu).
4. Zinc ore (Zn) : by both gravimetric and volumetric methods.

5. Lead ore (Pb,S).

6. Silver coin (Au, Ag, Pb, Zn).

Chemical Philosophy.—Tilden. Chemical calculations. Thorpe and Tate. (3).

Assaying.—Including the assay by the dry methods of gold, silver, antimony, lead, iron, and tin ores, coal, and gold and silver bullion. Laboratory work. Ricketts. (3)

Economics.—Elementary economics. (1)

English.—English and American Orators. (1)

SECOND TERM.

Mineralogy.—Descriptive mineralogy, with practical exercises in the determination of minerals : E. S. Dana. (3)

Blow-Pipe Analysis.—Lectures, with practice. Plattner, Brush, or Nason and Chandler. (1)

Chemistry.—Fresenius' Quantitative Analysis. Laboratory work. (3) The following analyses are executed by the student :

7. Copper alloys (Cu, Sn, Zn, Pb).

8. Spiegeleisen (Mn) : by both gravimetric and volumetric methods.

9. Iron ore (complete analysis).

10. Limestone (complete analysis).

11. Coal (volatile matter, fixed carbon, ash, H_2O , S, P).

Steam Engine.—Holmes's Steam Engine. (4)

Metallurgy.—Metallurgical processes. Furnaces. Refractory building materials. Combustion. Natural and artificial fuels. Metallurgy of iron. (5)

English.—British Essayists. (1)

SENIOR CLASS.

FIRST TERM.

Metallurgy.—Of copper, lead, silver, gold, etc. (4)

Blow-Pipe Analysis.—Practice. (1)

Lithology.—Williams' Lithology, with practical exercises in determining rocks. (3)

Chemistry.—Fresenius' Quantitative Analysis. Laboratory work. (4) The following analyses are executed by the student :

12. Slag (complete analysis).
13. Pig iron (complete analysis).
14. Carbon in steel (volumetric).
15. Nickel ore (Ni, Co).
16. Gas analysis.

Hydraulics.—Hydrostatics. Flow of water in pipes and channels. Hydraulic motors. (3)

Measurement of Power.—Indicating of steam engines ; determination of evaporative efficiency of boilers ; dynamometer experiments. (1)

SECOND TERM.

Ore Dressing.—Mechanical preparation of ores. Coal washing. Lectures. (3)

Drawing.—Designing of furnaces and other metallurgical plant. (2)

Mechanics of Machinery.—Hoisting machinery, accumulators, pumps, pumping-engines, blowing-engines, compressors, and fans. (4)

Geology.—General geological definitions and principles. Dynamic and historic geology. Dana. Lectures. (4)

Measurement of Power. (1)

Christian Evidences.—Lectures. (1)
Preparation of Thesis.

SUMMER SCHOOL.*

Topographic Surveying.—Field work with transit and stadia and with plane table. Topographic maps.

GRADUATE YEAR.

FIRST TERM.

Mining.—Prospecting. Economic geology. Boring. Valuation of property. Timbering and walling. Support of excavations. Tunneling. Systems of mining. Lectures. (4)

Mechanics of Machinery.—Herrmann-Smith. Graphical Statics of Mechanisms. (2)

Drawing.—General views of mining plant and detailed sketches. (5)

Geodetic Surveying.—Use of solar transit and sextant. Precise triangulation. Elements of geodesy. Determination of the systematic errors of instruments. (3)

Mine Surveying.—Theory and problems, with maps drawn from actual surveys. (2)

SECOND TERM.

Projects.—In mining. Designing of mining plant. (4)

Mining.—Underground transportation. Hoisting, drainage, and pumping. Ventilation and lighting. Hygiene of mines. Mining law. Lectures. (4)

Geological Surveying.—Theory, practice, and map drawing. (2)

Railroad Surveying.—Theory of railroad curves. Railroad reconnaissance and location. Survey of a line, with profile, map, and estimate of cost. (4)

Preparation of Thesis.

THE COURSE IN MINING.

This course is arranged so that the subjects included in the practice of mining and ore dressing will be covered in

*For candidates for the degree of E. M.

four years, when the graduate will receive the degree of Bachelor of Science in Mining (B.S.), and by an additional year of post-graduate work can obtain that of Engineer of Mines (E.M.).

FRESHMAN CLASS.

FIRST TERM.

See page 51.

SECOND TERM.

Mathematics.—Analytical geometry. (3) Plane and spherical trigonometry and mensuration. Use of logarithmic tables. (2)

Physics.—Mechanics. (3)

Drawing.—Tracings and blue prints. Sections of simple construction. Intersections of spheres, cones, cylinders, etc., illustrated from examples of mining and metallurgical plant. (4)

German.—Dictation. Compositions. Beresford-Webb: German Historical Reading Book. Freytag: Aus dem Staate Friedrichs des Grossen. Readings from Lessing, Schiller, Goethe. (3) Or *French.*—Dictation. Compositions. Mérimée: Colomba. Halévy: L'abbé Constantin. Daudet: Choix de Contes. Molière: L'Avare. Super: Readings from French History. Readings from Victor Hugo, Balzac, Dumas. (3) Conversation class in both languages optional throughout the year.

English.—History of the English language. (2) Essays.

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Elementary mechanics. Calculus begun. (5)

Drawing.—Sketches and working drawings of machine pieces. Interpretation of drawings by isometric sketches. General views from given details. Graphical problems illustrating the direction and extent of throw in faults. (2)

Physics.—Heat, electricity and magnetism. Lectures and recitations. (3) Mechanics, heat. Laboratory. (1)

Crystallography.—Lectures, with practical exercises in the determination of crystals. (2)

Land Surveying.—Theory and use of level and transit. Field practice and map drawing. (2)

English.—English literature. (2) Essays.

SECOND TERM.

Mathematics.—Differential and integral calculus, completed. Analytical mechanics. (5)

Physics.—Electricity and magnetism, light, sound. (3)

Mineralogy.—Descriptive mineralogy, with practical exercises in the determination of minerals: E. S. Dana. (3)

Blow-Pipe Analysis.—Lectures, with practice: Plattner, Brush, or Nason and Chandler. (1)

Chemistry.—Lectures and laboratory practice. Douglas and Prescott's Qualitative Analysis. (3)

English.—English prose literature. (2) Essays.

SUMMER SCHOOL.

Topographic Surveying.—Field work with transit and stadia, and with plane table. Topographic maps.

JUNIOR CLASS.

FIRST TERM.

Mining.—Prospecting. Economic geology. Boring. Valuation of property. Timbering and walling. Support of excavations. Tunneling. Systems of mining. Lectures. (4)

Lithology.—Williams' Lithology, with practical exercises in determining rocks. (3)

Strength of Materials.—Elasticity and strength of wood, stone, and metals. Theory of beams, columns, and shafts. Reports on the testing of materials. (4)

Assaying.—Including the assay by the dry method of gold, silver, antimony, lead, iron, and tin ores, coal, gold and silver bullion, and rich lead. Ricketts. (3)

Economics.—Elementary course. (1)

English.—English and American Orators. (1)

SECOND TERM.

Geology.—General geological definitions and principles. Dynamic and historic geology. Lectures. Dana. (4)

Mining.—Underground transportation. Hoisting, drainage, and pumping. Ventilation and lighting. Hygiene of mines. Mining law. Lectures. (4)

Ore Dressing.—Mechanical preparation of ores. Coal washing. (3)

Steam Engine.—Holmes' Steam Engine. (4)

Economics.—Economic problems. (1)

English.—British Essayists. (1)

SENIOR CLASS.

FIRST TERM.

Drawing.—General views of mining plant and detailed sketches. (5)

Geodetic Surveying.—Use of solar transit and sextant. Precise triangulation. Elements of geodesy. Determination of the systematic errors of instruments. (3)

Hydraulics.—Hydrostatics. Flow of water in pipes and channels. Hydraulic motors. (3)

Mechanics of Machinery.—Herrmann-Smith. The Graphical Statics of Mechanisms. (2)

Mine Surveying.—Theory and problems, with maps drawn from actual surveys. (2)

Measurement of Power.—Indicating of steam engines; determination of evaporative efficiency of boilers; dynamometer experiments. (1)

SECOND TERM.

Projects.—In mining. Designing of mining plant. (4)

Railroad Surveying.—Theory of railroad curves. Railroad reconnaissance and location. Survey of a line, with profile, map, and estimate of cost. (4)

Mechanics of Machinery.—Hoisting machinery, accumulators, pumps, pumping-engines, blowing-engines, compressors, and fans. (4)

Geological Surveying.—Theory, practice, and map drawing. (2)

Measurement of Power.—Indicating of steam engines ; determination of evaporative efficiency of boilers ; dynamometer experiments. (1)

Christian Evidences.—Lectures. (1)

Preparation of Thesis.

GRADUATE YEAR.

FIRST TERM.

Chemical Philosophy.—Tilden. Chemical calculations. Thorpe and Tate. (3)

Blowpipe Analysis.—Practice. (1)

Metallurgy.—Of copper, lead, silver, gold, etc. (4)

Drawing.—Metallurgical construction. (4)

Chemistry.—Fresenius' Quantitative Analysis. (5)

The following analyses are executed by the student :

1. Iron wire (Fe).
2. Potassium Dichromate (Cr_2O_3).
3. Copper ore (Cu).
4. Zinc ore (Zn) : by both gravimetric and volumetric methods.
5. Lead ore (Pb, S).
6. Silver coin (Au, Ag, Pb, Zn).
7. Copper alloys (Cu, Sn, Zn, Pb).
8. Spiegeleisen (Mn) : by both gravimetric and volumetric methods.

SECOND TERM.

Metallurgy.—Metallurgical processes. Furnaces. Refractory building materials. Combustion. Natural and artificial fuels. Metallurgy of iron. (5)

Drawing.—Metallurgical design. (2)

Chemistry.—Fresenius' Quantitative Analysis. Laboratory work. (6) The following analyses are executed by the student :

9. Iron ore (complete analysis).
10. Limestone (complete analysis).

11. Coal (volatile matter, fixed carbon, ash, H_2O , S, P).
12. Slag (complete analysis).
13. Pig iron (complete analysis).
14. Carbon in steel (volumetric).
15. Nickel ore (Ni, Co).
16. Gas analysis.

Thesis.

THE COURSE IN ELECTRICAL ENGINEERING.

The object of this course is to provide instruction in the elementary sciences, mathematics, and electrotechnology, supplemented by the study of the strength of materials, the mechanics of machinery, machine design, thermodynamics, and hydraulics.

The elementary course in Mechanics, Heat, Electricity and Magnetism, Light, and Sound begins with the second term of the Freshman year and extends to the end of the Sophomore year. This work is common to all the technical courses.

Students in Electrical Engineering pursue the mathematical theory of electricity and magnetism during the first term of the Junior year and an extended course in the electrical laboratory throughout the Junior year. The electrotechnical work begins with the second term of the Junior year, when the student takes up the technical study of telegraphs and telephones and begins the elementary theory of dynamos and motors and the theory of alternating currents. The Senior year is devoted to electrical designing, the theory of alternating currents, electric lighting, power transmission, dynamo laboratory and heavy electrical testing, electro-metallurgy, and thesis work.

A laboratory fee is charged to students to cover the cost of laboratory supplies. Students taking one laboratory exercise per week are required to pay \$3.50 per term; students taking two laboratory exercises per week are required to pay \$5.00 per term; and students taking three laboratory exercises per week are required to pay \$6.50 per term.

The student who completes all the studies of this course will receive the degree of Electrical Engineer (E E.).

For the benefit of graduates in Electrical Engineering who desire to study the advanced portions of electrical science, instruction is offered in the mathematical theory of electricity and magnetism, in the advanced theory of alternating currents, and in mathematical physics in general.

FRESHMAN CLASS.

FIRST TERM.

See page 51.

SECOND TERM.

Mathematics.—Analytical geometry. (3) Plane and spherical trigonometry and mensuration. Use of logarithmic tables. (2)

Physics.—Mechanics. (3)

Drawing and Machine Design.—Tracings and blue prints. Sketches and working drawings of machine pieces. Interpretation of machine drawing by isometric sketches. General views from given details. Sections of stub ends and valve passages. Intersection of boiler flues. Empirical proportioning of machine parts. (4)

German.—Dictation. Compositions. Beresford-Webb: German Historical Reading Book. Freytag: Aus dem Staate Friedrichs des Grossen. Readings from Lessing, Schiller, Goethe. (3) Or *French.*—Dictation. Compositions. Mérimée: Colomba. Halévy: L'abbé Constantin. Daudet: Choix de Contes. Molière: L'Avare. Super: Readings from French History. Readings from Victor Hugo, Balzac, Dumas. (3) Conversation class in both languages optional throughout the year.

English.—History of the English language. (2) Essays.

SUMMER SCHOOL.

Visits of Inspection.—Examination and sketching of machine parts and of electrical apparatus and machinery.

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Elementary mechanics. Calculus begun.

(5)

Physics.—Heat, electricity and magnetism. Lectures and recitations. (3) Mechanics, heat. Laboratory. (1)

Machine Design.—Proportioning of such machine parts as come under the head of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers, and connecting rods. (3)

Boilers.—Peabody and Miller. Strength, construction, and wear and tear of boilers. (1)

French.—Whitney's Practical Grammar. Super's Reader. (2) Or *German*.—Joynes-Meissner's Advanced Grammar. Buchheim's Reader. (2)

English.—English literature. (2) Essays.

SECOND TERM.

Mathematics.—Differential and integral calculus, completed. Analytical mechanics. (5)

Steam Engine.—Holmes' Steam Engine. (4)

Physics.—Electricity and magnetism, light, and sound. Lectures. (3) Physical laboratory. (1)

French.—Grammar and reader (continued). (2) Or *German*.—Grammar and reader (continued). Short stories by different modern authors. (2)

English.—English prose literature. (2) Essays.

JUNIOR CLASS.

FIRST TERM.

Mathematics.—Differential equations. (2)

Electricity.—Advanced course in the theory of electricity and magnetism. (4)

Electrical Laboratory.—Course in electrical measurements. (3)

Strength of Materials.—Elasticity and strength of wood, stone, and metals. Theory of beams, columns, and shafts. Reports on the testing of materials. (4)

Surveying.—Theory and use of instruments. Land surveying and leveling. Location of electric railways. (2)

French.—Grammar. George Sand : *La Mare au Diable*. Dumas : *Pauline*. (2) Or *German*.—Advanced grammar. Short stories by different modern authors. (2)

Economics.—Elementary economics. (1)

English.—English and American Orators. (1)

SECOND TERM.

Dynamo-electric Machinery.—Direct-current generators and motors. Text-book : Jackson's *Electro-Magnetism and the Construction of Dynamos*. (3)

Electrical Designing. (1)

Alternating Currents.—The analytical and graphical treatment of alternating currents. (2)

Electrical Laboratory.—Continuation of course in electrical measurements. (2)

Telegraphs and Telephones.—Lectures. (3)

Chemistry.—Lectures and laboratory practice. Douglass and Prescott's *Qualitative Analysis*. (3)

French.—Advanced grammar. Short stories by François Coppée and Guy de Maupassant. Vigny : *Le Cachet Rouge*. Dictation. (2) Or *German*.—Advanced grammar. Beresford-Webb : *German Historical Reading Book*. Freytag : *Aus dem Staate Friedrichs des Grossen*. Dictation. (2)

Economic.—Economic problems. (1)

English.—British essayists. (1)

Christian Evidences. (1)

SENIOR CLASS.

FIRST TERM.

Dynamo-electric Machinery.—Alternators and transformers. (2)

Electrical Designing.—Lectures. (2)

Alternating Currents. (2)

Electric Lighting and Station Visits. (2)

Dynamo Laboratory. (3).

Measurement of Power.—Indicating of steam engines and dynamometer experiments. (1)

Mechanics of Machinery.—Herrmann-Smith. The Graphical Statics of Mechanisms. (2)

Thermodynamics. (3)

Four lectures on recent advances in Electrical Engineering.

SECOND TERM.

Alternating Currents. (2)

Dynamo-electric Machinery.—Polyphase apparatus. (2)

Electrical Designing. (2)

Dynamo Laboratory. (3)

Electro-metallurgy.—Lectures. (1)

Electric Power and Station Visits. (2)

Hydraulics.—Flow of water through orifices, pipes, and channels. Hydraulic motors. (3)

Preparation of Thesis.

Four lectures on recent advances in Electrical Engineering.

THE COURSE IN CHEMISTRY.

This course of study is designed to prepare students for the profession of the chemist, in connection with metallurgical establishments, sugar refineries, gas works, superphosphate works, electrical machinery manufactories, mining companies, etc., and the general consulting and analytical work of the professional chemist. It is also well adapted to the preparation of teachers of chemistry and as a course preliminary to the study of medicine. It is eminently practical, the student's time being largely occupied by practical work in the large, well equipped and well ventilated chemical laboratories, which were completed in 1885 and constitute the best constructed building for this purpose in this country. The museum of chemistry contains large collections of specimens for illustrating the lectures on theoretical and applied chemistry.

THEORETICAL CHEMISTRY.—Instruction in this subject

begins with lectures twice a week in the first term of the Freshman year. These lectures are fully illustrated by experiments, colored diagrams, working drawings and lantern pictures, and specimens from the museum. They include a general introduction to theoretical chemistry and a description of the non-metallic and metallic elements and their compounds, the general subject of inorganic chemistry. The students are required to take notes of the lectures and to pass a written examination at the end of the term. There is also a course of experimental chemistry in the laboratory; six hours per week are required.

In the second term of this year stoichiometry and chemical problems and reactions are taught by recitations twice each week.

The study of theoretical chemistry is continued throughout the Sophomore year by recitations three times a week from Tilden's Chemical Philosophy, Thorpe and Tate's Chemical Problems, and Remsen's Advanced Chemistry; in the first term of the Junior year by a course of lectures and recitations on theoretical organic chemistry four times a week. These lectures are illustrated by experiments and by specimens from the museum of chemistry.

Written examinations are held at the close of each of the above courses.

ANALYTICAL CHEMISTRY.—Qualitative analysis is taught in the second term of the Freshman year by lectures, recitations, and practical work in the qualitative laboratory, fifteen hours of practical work per week being required. This laboratory is a large, well ventilated and well lighted room, supplied with convenient working tables, vacuum filtration, hoods for noxious vapors, steam baths, gas and washing appliances, and a commodious room for hydro-sulphuric acid. Distilled water is delivered by faucet in this room and the other large laboratories. At the close of the term a practical examination is held in this subject.

After completing this course, quantitative analysis is pursued throughout the Sophomore and the first term of the Junior years. This subject is taught by lectures, reci-

tations, and practical work in the quantitative laboratory, which is equipped like the qualitative laboratory, but is supplied in addition with apparatus for drying precipitates and residues, rooms for the chemical balances, for combustions, and for a reference library.

Fifteen hours per week of laboratory work are required.

The course consists in gravimetric and volumetric analyses, as applied to the substances given in the lists farther on, accuracy being required in the determination of each constituent.

At the close of each term written examinations are held upon the theory and practice of quantitative analysis.

GAS ANALYSIS is taught by lectures and laboratory practice in the gas laboratory. This laboratory is supplied with full and complete apparatus for gas analysis, according to Bunsen's processes, as well as apparatus for some of the more rapid methods. Mixtures of gases are required to be analyzed by the students, within certain limits of error, and a written examination, on the theory and practice, is held at the close of the course.

ASSAYING.—The assaying of ores by furnace assay, together with gold and silver bullion analysis, by processes practiced in the United States Mint, is taught by lectures and practical work in the first term of the Senior year, nine hours of practical work per week being required. The course includes the assaying of ores of lead, tin, antimony, gold, silver, and iron, coal, and gold and silver bullion.

The assaying laboratory is supplied with large working tables, twenty-nine crucible and two iron furnaces, and eight muffle furnaces, with adjoining rooms for balances, and gold and silver bullion analysis.

A certain accuracy of results and a written examination as regards theory and practice are required.

ORGANIC CHEMISTRY.—The practical work in this subject is performed in the second term of the Junior year, eighteen hours per week being required, with conferences and recitations each week. The laboratory for this work

is equipped similarly to the quantitative laboratory, in addition being supplied with steam, cold water and air blast upon the working tables, and a full supply of apparatus for the various determinations and experiments, including combustion furnaces, furnaces for heating sealed tubes, mercury pump, Hoffman's, Dumas' and Meyer's apparatus for vapor densities, nitrometers, chemical balances, etc.

The course consists of determinations of specific gravities, melting points, boiling points, vapor densities; chlorine, bromine, iodine, and sulphur of organic substances.

Combustion analysis, nitrogen determination, fractional distillation, and the preparation of fifty pure organic compounds and a number of analyses are included.

INDUSTRIAL CHEMISTRY.—A course of lectures is delivered upon this subject in the second term of the Senior year, illustrated by experiments, diagrams, lantern pictures, and specimens from the museum of chemistry. The working laboratories for this subject contain an apparatus for making illuminating gas, an alcohol still, worm and doubler, and a complete working model of a sugar refinery, including filters, vacuum pan, and centrifugal. There is also apparatus for use in the manufacture of chemicals, for dyeing, calico printing, and bleaching. In connection with these laboratories is a room containing a photometer and apparatus for determining the sulphur, ammonia, and specific gravity of illuminating gas; also a laboratory for the testing of alcoholic liquors, sugar, molasses, bone black, soap, petroleum, paints, dyes, superphosphates, tallow, illuminating and lubricating oils, rubber, explosives, paints, asphalts, and other commercial products, with the necessary technical apparatus. The students make practical experiments in this direction, and, with an instructor, visit various industrial establishments in this neighborhood and in and around New York City. Fifteen hours of laboratory work are required each week throughout the Senior year.

TOXICOLOGY.—A course of lectures on this subject is given in the first term of the Junior year, illustrated by experiments and by the large collection of specimens of poisons from the museum of chemistry. This is supplemented by a short course of laboratory work on some of the common poisons.

SANITARY CHEMISTRY.—During the second term of the Senior year attention is given to the qualitative and quantitative examination of air, water, food, disinfectants, baking-powders, flour, bread, tea, coffee, cocoa, spices, milk, butter, lard, beer, and other subjects connected with this branch of the science. Special apparatus is provided for this work, as recommended by the best authorities on the subject.

PHOTOGRAPHIC CHEMISTRY.—A well equipped photographic laboratory and dark rooms are provided, in which the students of the chemical course receive practical instruction.

PHYSIOLOGICAL CHEMISTRY.—The examination of urine, blood, organic and inorganic poisons, etc., receives a proper amount of attention.

The course also includes instruction in physics, mineralogy, blowpipe analysis, metallurgy, and geology, which are of great value to the chemist.

MICROSCOPY.—Instruction in the use of the microscope is given in the first term of the Senior year, six hours of laboratory work each week being required.

In the Senior year the student is required to prepare a thesis on some subject, selected by the Professor of Chemistry, involving practical work in the laboratory in addition to the literary labor, each graduate thus making a contribution to the progress of the science, as a preliminary to the reception of his degree.

The graduate of this course receives the degree of Analytical Chemist (A.C.).

Students not candidates for a degree are admitted to

special courses in chemistry, of which they will receive certificates.

The laboratories are under the immediate charge of the Professor and Instructors of Chemistry and are open to the students from 8 o'clock A. M. to 6 o'clock P. M., including Saturdays. Students are at liberty to work in the laboratories beyond the required hours as their time may permit. Students are charged for materials and apparatus consumed; with moderate care this expense need not exceed \$50 per year.

FRESHMAN CLASS.

FIRST TERM.

See page 51.

SECOND TERM.

Mathematics.—Plane and spherical trigonometry and mensuration. Use of logarithmic tables. (2)

Chemistry.—Lectures and laboratory practice. Douglas and Prescott's Qualitative Analysis. (5)

Physics.—Mechanics. (3)

Stoichiometry. (2)

German.—Dictation. Compositions. Beresford-Webb: German Historical Reading Book. Freytag: Aus dem Staate Friedrichs des Grossen. Readings from Lessing, Schiller, Goethe. (3) Or *French.*—Dictation. Compositions. Mérimée: Colomba. Halévy: L'abbé Constantin. Daudet: Choix de Contes. Molière: L'Avare. Super: Readings from French History. Readings from Victor Hugo, Balzac, Dumas. Conversation class in both languages optional throughout the year.

English.—History of the English language. (2) Essays.

SOPHOMORE CLASS.

FIRST TERM.

Chemical Philosophy.—Tilden. Chemical problems. Thorpe and Tate. (3)

Quantitative Analysis.—Fresenius' Quantitative Analysis. (5)

The following analyses are executed by the student :

1. Iron wire (Fe).
2. Potassium dichromate (Cr_2O_3).
3. Barium chloride (Ba , Cl , H_2O).
4. Magnesium sulphate (MgO , SO_3 , H_2O).
5. Disodium hydrogen phosphate (P_2O_5).
6. Rochelle salt (K_2O , Na_2O).
7. Volumetric determination of chlorine.
8. Acidimetry (HCl , H_2SO_4 , HNO_3 , $\text{HC}_2\text{H}_3\text{O}_2$).
9. Alkalimetry (KOH , NaOH , NH_4OH , soda ash, pearl ash).
10. Chlorimetry (bleaching powders).
11. Copper ore (Cu).
12. Zinc ore (Zn). By both gravimetric and volumetric methods.

Quantitative Analysis.—Conference. (1).

Physics.—Heat, electricity and magnetism. Lectures, with study of text-book. (3) Mechanics, heat. Laboratory. (1)

English.—English literature. (2) Essays.

SECOND TERM.

Physics.—Electricity and magnetism, light, sound. Lectures and recitations. (3)

Quantitative Analysis.—Fresenius' Quantitative Analysis. (6)

The following analyses are executed by the student :

13. Lead ore (Pb , S).
14. Silver coin (Au , Pb , Ag , Cu).
15. Spiegeleisen (Mn). By both gravimetric and volumetric methods.
16. Copper alloys (complete analysis).
17. Ilmenite (TiO_2).
18. Iron ore (complete analysis).
19. Limestone (complete analysis).
20. Coal (volatile matter, fixed carbon, ash, H_2O , S , P).
21. Slag (complete analysis).

Quantitative Analysis.—Conference. (1)
Chemistry.—Remsen. Advanced course. (3)
English.—English prose literature. (2) Essays.

JUNIOR CLASS.

FIRST TERM.

Toxicology.—Lectures. (2)

Quantitative Analysis.—Fresenius' Quantitative Analysis. (5)

The following analyses are executed by the student :

22. Guano (NH_3 , P_2O_5 , H_2O).
23. Clay (complete analysis),
24. Manganese ore (MnO_2).
25. Mineral water (complete analysis).
26. Pig iron (complete analysis).
27. Nickel ore (Ni , Co).
28. Carbon in steel (colorimetric).
29. Gas analysis.

Quantitative Analysis.—Conference. (1)

Organic Chemistry.—Lectures and recitations. (4)

Crystallography.—Lectures, with practical exercises in the determination of crystals. (2)

Economics.—Elementary economics. (1)

English.—English and American Orators. (1)

SECOND TERM.

Organic Chemistry.—Laboratory. (6)

Organic Chemistry.—Conference. (1)

Metallurgy.—Metallurgical processes. Furnaces. Refractory building materials. Combustion. Natural and artificial fuels. Metallurgy of iron. (5)

Mineralogy.—Descriptive mineralogy, with practical exercises in the determination of minerals. E. S. Dana. (3)

Blowpipe Analysis.—Lectures, with practice. Plattner, Brush, or Nason and Chandler. (1)

English.—British essayists. (1)

SENIOR CLASS.

FIRST TERM.

Metallurgy.—Of copper, lead, silver, gold, etc. (4)

Assaying.—Including the assay by the dry method of gold, silver, antimony, lead, iron, and tin ores, coal, gold and silver bullion, and rich lead. Ricketts. (3)

Industrial Chemistry.—Laboratory. (3)

Geology.—Williams' Lithology, with practical exercises in determining rocks. (3)

Microscopy.—Laboratory. (2)

Blowpipe Analysis.—Practice. (1)

Preparation of Thesis.

SECOND TERM.

Industrial Chemistry.—Lectures. (3)

Industrial Analysis.—Laboratory. (3)

Industrial Analysis.—Conference. (1)

Agricultural Chemistry.—Laboratory. (1)

Sanitary Chemistry.—Laboratory. (1)

Geology.—Historic and dynamic geology. Lectures. LeConte. (3)

Christian Evidences.—Lectures. (1)

Preparation of Thesis. (4)

PHYSICAL CULTURE.

The Gymnasium is open morning, afternoon, and evening; in all, 45 hours a week. Exercise in it is required of all students who are fitted to take it. Class drill with the Instructor and individual exercise are prescribed.

GRADUATING THESES.

Every student is required to present a thesis upon some topic connected with the course from which he is to graduate, as a necessary portion of the exercises for his final examination for a diploma. These theses are accompanied by drawings and diagrams, when the subjects need such illustration. The originals are kept by the University, as a

part of the student's record, for future reference ; but a copy may be retained by the student, and be published, permission being first obtained from the President.

DIPLOMAS AND CERTIFICATES.

The Diploma is given only to those who have passed all the examinations in a regular course and is signed by the Secretary of the Board of Trustees and by the Faculty of the University. For all partial courses a certificate is given, signed by the Secretary of the Faculty, and showing what the student has accomplished.

GRADUATE STUDENTS.

Graduate students wishing to remain a year or more and pursue a course of study as candidates for another Degree may do so with the sanction of the Faculty. Those wishing to take *special* courses of study will be afforded every facility for so doing.

GRADUATE DEGREES.

M. A.

The Faculty will recommend for the Degree of Master of Arts any candidate, otherwise properly qualified, who, after taking at this University the Degree of Bachelor of Arts, shall pursue, for at least one year at this University, or two years elsewhere, a course of liberal study prescribed by the Faculty in at least two departments (under at least two professors), pass a thorough examination in the same, and present a satisfactory Thesis.

M. S.

The Faculty will recommend for the Degree of Master of Science any candidate, otherwise properly qualified, who, after taking at this University any Degree in the School of Technology, shall pursue, for at least one year at this University, a course of study prescribed by the Faculty in at least two departments (under at least two professors), pass a thorough examination in the same and

present a satisfactory Thesis. Graduates of the Latin-Scientific Course, or of that of Science and Letters, are permitted to study *in absentia* for the degree of M.S., subject to the same restrictions as those prescribed for candidates for the degree of M.A.

The Theses presented by candidates for Graduate Degrees are retained by the University.

Applicants for either of these degrees will be required to complete the prescribed work within the allotted time. Special action of the Faculty is required for any extension of time.

THE UNIVERSITY LIBRARY.

The Library building was erected by the Founder of the University in 1877, at a cost of \$100,000, as a memorial of his daughter, Mrs. Lucy Packer Linderman, and during the same year more than \$20,000 were contributed by her family and friends as a memorial fund for the purchase of books. By the will of the Founder of the University a fund of \$500,000 has been given for the permanent endowment of the library.

The building is semi-circular in plan, with a handsome façade in the Venetian style of architecture. It is constructed of Potsdam sandstone with granite ornamentation. In the interior, the center is occupied as a reading space, fifty by forty feet, from which radiate the book cases, extending from floor to ceiling; two galleries affording access to the upper cases. Shelf room is now provided for one hundred and sixty thousand volumes. The building is thoroughly fireproof, well lighted, and heated by steam.

Ninety-seven thousand volumes are now upon the shelves, including many extremely valuable works. The list of periodicals numbers about two hundred and fifty, embracing as far as possible all departments of knowledge.

The Library is conducted strictly for consultation, and is open to the use of the public; both of which conditions are in accord with the terms of the gift.

REGULATIONS OF THE LEHIGH UNIVERSITY LIBRARY.

- I. The Library is open every day, except Sundays and Legal Holidays, from 8 A.M. until 10 P.M., and on Sundays for the students and others connected with the University from 1:30 P.M. until 9:30 P.M.
- II. Admission is free to all persons over 16 years of age.
- III. Readers are required to write their names and addresses in the Daily Register of the Library. They also write the name of the book desired upon a Library Card, with their signatures, and present the same to the Director's Clerk, who supplies the book, retaining the card as a receipt. Before leaving the Library, readers return their books to the clerk, and receive their cards.
- IV. The University Professors and Instructors, only, are allowed to take books from the Library Building.
- V. No person is allowed to enter the alcoves, or remove any book from the shelves, without permission of the Director.
- VI. Readers wishing to consult the more valuable illustrated works make special application for that purpose.
- VII. In taking notes, pencils, and not pen and ink, are to be used.
- VIII. Audible conversation and the use of tobacco are strictly forbidden in any part of the Library.
- IX. Any person not conforming to these Regulations will be denied the privileges of the Library.
- X. Any person who defaces, in any way, any book magazine or paper, or the furniture, or any portion of the building, in addition to being deprived of the privileges of the Library, will be prosecuted according to law.

THE ECKLEY B. COXE MEMORIAL LIBRARY.

In memory of the Honorable Eckley B. Coxe, who was for many years a Trustee of the University and who was profoundly interested in its welfare, Mrs. Coxe has pre-

sented to the University his technical library, consisting of 7727 volumes, together with 3429 pamphlets. As the working library of a man who was remarkable as well for the breadth of his culture as for the extent and thoroughness of his acquaintance with the whole field of applied science, this addition to the resources of the University possesses the greatest value for all professional students.

OBSERVATORY.

By the liberality of Robert H. Sayre, Esq., one of the Trustees of the University, an astronomical observatory was erected on the University grounds, and placed under the charge of the Professor of Mathematics and Astronomy.

In the dome of the observatory is mounted an equatorial telescope, of six inches aperture, by Alvin Clark & Sons. The west wing contains a superior sidereal clock, by Wm. Bond & Sons; a zenith telescope, by Blunt, and a field transit, by Stackpole. There is also a prismatic sextant, by Pistor & Martins.

Students in practical astronomy receive instruction in the use of the instruments and in actual observation.

The land upon which the Observatory stands, consisting of seven acres adjoining the original grant, was presented to the University by Charles Brodhead, Esq., of Bethlehem.

THE UNIVERSITY MUSEUM.

In addition to the large collection illustrating all branches of Industrial Chemistry, the Museum includes collections in Metallurgy, Geology, Zoölogy, and Archæology.

The Metallurgical Cabinet already includes specimens illustrating the various processes for obtaining the more common metals.

The Zoölogical Cabinet includes the Werner collection of nearly all the types of American birds with their nests and eggs, and the Packer collection of recent shells.

The Geological Cabinet numbers over ten thousand specimens and includes the Palæontological, Mineralogical, Petrographic, and Economic collections. The first contains good specimens of nearly all the common genera. The Mineralogical division includes the Keim and Roep-per collections—the latter being especially complete and valuable from a crystallographic standpoint. The Petro-graphic division numbers several thousand specimens and, besides including numerous varieties of nearly all the rocks of the globe, contains a duplicate set from the collection of the Second Geological Survey of this State. The Economic division was formed and given by Dr. James P. Kimball, ex-Director of the Mint, and formerly Professor of Economic Geology.

The Cummings Archæological Cabinet numbers three thousand specimens and includes Dr. Stubbs's collection of Indian relics, weapons, and utensils.

SUMMER SCHOOL IN SURVEYING.

The regular course in topographic surveying for students in civil and mining engineering is given in the summer vacation between the Sophomore and Junior years. An optional course in Land Surveying is also offered at the same time, for which a fee of \$15 is charged. These courses are open to a limited number of persons, not students at the University, who are qualified to pursue them, upon payment of the same fee. Application should be made to the professor of civil engineering before June 1st.

UNIVERSITY LECTURES.

From time to time during the University year, distinguished members of the various professions are invited to lecture before the student body upon those special subjects to which they have given particular attention and upon which they are authorities.

CHEMICAL AND NATURAL HISTORY SOCIETY OF THE LEHIGH UNIVERSITY.

This Society was organized in the Fall of 1871, as "The Chemical Society," but was afterwards expanded, as its present title indicates, and admits, by election, students from all departments of the University.

The collections of botanical and zoölogical specimens belonging to the Society are already important. During the past years persons have been sent to Texas and Brazil to collect specimens for these cabinets.

The Society has organized and maintained several courses of public scientific lectures.

THE ENGINEERING SOCIETY.

This Society was organized in 1873, and admits, by election, students in the Junior and Senior Classes. Its meetings are held fortnightly. At these, papers relating to engineering subjects are read and discussed. From 1885 to 1890 it issued quarterly five volumes of "The Journal of the Engineering Society," containing contributions by the members, alumni, and others. Many of the papers read before this society from 1890 to 1893 were published in "The Lehigh Quarterly."

The society includes in its membership students from all the engineering courses of the University. In addition to the general organization of the society, with fortnightly meetings as above stated, the representatives of the Civil and Mechanical Engineering courses form subordinate sections, with separate organizations and stated meetings, for the discussion of subjects of particular interest.

THE ELECTRICAL ENGINEERING SOCIETY

was organized in November, 1887. Its object is to supplement the regular work of the department by the study and discussion of electrical subjects.

THE AGORA AND THE FORUM

are literary and debating societies which meet semi-monthly. The Agora is the older society and was formerly restricted in its membership to students in the School of General Literature, but in 1893 it was thrown open to all students; and shortly afterward the Forum was organized. These societies have proved of great advantage to their members in the development of concise and logical thinking, in the promotion of ease before an audience, and in the acquirement of experience in parliamentary methods. Through these societies the University is represented in the Pennsylvania Intercollegiate Oratorical Union, and at the annual contest of the Union held at Allentown, March, 1897, the first prize was won by Lehigh's representative, Basil George Kodjbanoff. An annual contest in debate is held with representatives of the literary societies of Lafayette College. The societies have justified their existence by the great increase in the amount of attention given, not only to training in oratory and debate, but also to those subjects of the day which are constantly discussed at their meetings.

THE MATHEMATICAL CLUB.

This club was organized in February, 1895. Its members are students in the Junior and Senior classes. Its object is to continue the study of higher mathematics after having completed the mathematical course of the University. It holds frequent meetings at which papers are read and discussed by its members.

THE LEHIGH UNIVERSITY CHRISTIAN ASSOCIATION.

This is a voluntary organization of the students for the promotion of the religious, moral, and social life of the University. It was organized April 18, 1890, and on October 11, 1890, united itself with the Intercollegiate Young Men's Christian Association. The movement is

distinctly for and by students, all the officers being chosen from the student-body. Those connected with Evangelical churches of whatever creed are eligible to *active membership*; *associate membership* may be claimed by men of good moral standing who are not members of churches. The association is continually growing and is extending a marked influence for good among the men.

FOUNDER'S DAY.

On the second Thursday of October of each year, Commemorative Exercises are held in honor of the Founder of the University. On Thursday, October 14, 1897, the eighteenth Founder's Day was celebrated. An address was delivered by President James M. Taylor, D.D., LL.D., of Vassar College. His subject was "The Hope of the Republic."

UNIVERSITY SERMON.

This sermon is preached on the Sunday before University Day.

The Rev. Thomas B. Angell, D.D., of Harrisburg, was the preacher on Sunday, June 13, 1897, in the Packer Memorial Church.

THESES.

Theses on the following subjects were prepared by candidates for degrees in 1897:

FOR THE DEGREE OF MASTER OF SCIENCE.

JOSEPH BARRELL, B.S., E.M., New Providence, N. J.
The Geological History of the Archean Highlands of New Jersey,
including their Extension in New York and Pennsylvania.

FOR THE DEGREE OF ENGINEER OF MINES.

EDWARD WILLIAMSON MILLER, B.S., Bethlehem.
Magnetic Separation, with respect to the Wetherill Process.
JOHN AUGUSTUS THOMSON, B.S., Summit Point, W. Va.
A Discussion of the Pennsylvania Mining Code.

FOR THE DEGREE OF CIVIL ENGINEER.

- CHARLES MARSHALL BARTON, Pikesville, Md.
Design for a Foot Suspension Bridge over the Lehigh River at Bethlehem.
- SINCLAIR WIGGINS CHILES, Sims City, Fla.
Design for a Highway Cantilever Bridge over the Lehigh River at Bethlehem.
- BARTON OLMSTED CURTIS, Monona, Iowa.
Design for a Water Filter Plant for South Bethlehem.
- CLIFFORD GEORGE DUNNELLS, Pittsburg.
Design for a Steel Mill Building.
- WILLIAM THOMAS HANLY, Philadelphia.
The Foundations and Retaining Walls of the New Philadelphia Subway.
- HENRY HARRISON JONES, Reading.
Design for a Plate Girder Bridge to replace the Bridge over the Canal, on Main Street, Bethlehem.
- ESTEBAN A. MERCENARIO, Puebla, Mexico.
Design for a Water Supply System for the Port of Acapulco, Mexico.
- THADDEUS MERRIMAN, South Bethlehem.
Observations and Formulas for the Magnetic Declination at South Bethlehem.
- FRANK DOUGLASS MOUNT, Manasquan, N. J.
The Strength and Stiffness of Shafts for Ocean Steamers.
- ROBERT COLLYER NOERR, Washington, D. C.
Tests to Determine the Time of Setting of Hydraulic Cements by an Automatic Recording Machine.
- EUGENE PERONNEAN ROUNDY, East Orange, N. J.
Design for a Masonry Dam for a Reservoir at Castleton, N. Y.
- CHARLES FREDERICK SANDERS, Kutztown.
The Sewerage System and Sewage Filtration at Reading, Pa.
- SAMUEL PALMER SENIOR, Washington, D. C.
Plans for the Surface Drainage and Sewerage of South Bethlehem.
- FRANK BRADLEY SHEAFFER, New Bethlehem.
Plan for a Water Supply and Sewerage of New Bethlehem, Pa.
- EDWARD PETER SHUMAN, Allentown.
Design for a Bridge over Little Lehigh River at Allentown, Pa.
- JONATHAN EDWARD SLADE, Chicago, Ill.
Experiments on the Efficiency of a Turbine Water Wheel.

- MICHAEL THOMAS STACK, Shenandoah.
Review of the Water Supply System of Shenandoah, Pa.
- WALLACE TREICHLER, Elizabethtown.
Design for the Water Supply and Sewerage of Elizabethtown, Pa.
- CHARLES PARKER WAGONER, Phoenixville.
The Strength and Best Proportion for Car and Locomotive Axles.
- GILBERT CASE WHITE, Richmond, Va.
Experimental and Theoretical Investigation of the Stresses in a
Suspension Cable Due to Concentrated Loads.

FOR THE DEGREE OF MECHANICAL ENGINEER.

- FRANCIS DUPONT AMMEN, Ammendale, Md.
The Design of a Dynamometer for a Bicycle.
- LATHROP HUTCHINGS BALDWIN, Allentown.
Discussion of Machine Lubrication.
- WILLIAM BURKE BRADY, Harrisburg.
(with J. H. Pennington).
A Test of the Plant of the Harrisburg Water Works.
- ALBERT ANDREW FINKH, Yonkers, N. Y.
Efficiency of the Air Compressing Plant at the Bethlehem Pumping
Station.
- FRANCISCO MARTINEZ GALLARDO, Guadalajara, Mexico.
The Interchangeable System as a Factor in the Economical Manu-
facture of Machinery.
- HENRY TAYLOR IRWIN, Allegheny.
Plan of a System of Cranes for the Rosedale Foundry, Allegheny,
Pa.
- LAWRENCE RUST LEE, Shepherdstown, W. Va.
Motor Vehicles.
- WILLIAM ADAMS MEGRAW, Baltimore, Md.
Discussion of Balanced Slide Valves.
- HENRY H. NEWTON, Guadalajara, Mexico.
A Discussion of the Machinery Employed in the Manufacture of
Cane Sugar.
- HARRY RICHARDS PECK, Scranton.
The Design of an Electric Locomotive.
- JAMES HARKINS PENNINGTON, Philadelphia.
(with W. B. Brady).
A Test of the Plant of the Harrisburg Water Works.

- MORRIS HAVENS PUTNAM, Tioga.
Plans and Estimates for Increased Water Supply to Bayer Mill at
Tioga, Pa.
- JOHN PEAKE REYNOLDS, JR., Charleston, S. C.
Discussion of the High Duty Attachment to the Worthington Pump.
- SAMUEL STEWART RIEGEL, South Bethlehem.
A Device for Insuring Flooded Lubrication of a Car Journal.
- WOODFORD ROYCE, Willimantic, Conn.
Duty Test of Steam Pump at Natchang Pumping Station, Willi-
mantic, Conn.
- AUGUSTE LEOPOLD SALTZMAN, Plainfield, N. J.
Surface Condensers and Their Application to Marine Engines.
- FRANCIS BETTS SMITH, Hartford, Conn.
Discussion of Power Steering Gear for the Modern Steamship.
- JOHN LEEFE SHEPPARD, JR., Charleston, S. C.
Rice Chaff as Fuel.
- HARVEY WILSON SPRAGUE, South Bethlehem.
Rotary Motors ; also, an Efficiency Test of the Crowell Blower.
- WILLIAM EDWARD UNDERWOOD, Philadelphia.
and
- AMBROSE EVERETT YOHN, Saxton.
A Test of a Locomotive Boiler.

FOR THE DEGREE OF BACHELOR OF SCIENCE
(IN METALLURGY).

- HENRY JONATHAN BIDDLE BAIRD, West Chester.
Design of a Mill for the Reduction of Silver Ores by the Washoe
Process.
- JOHN BOYT, Adamsford.
Investigation of the Working of Blast Furnace A, Maryland Steel
Company, Sparrow's Point, Md.
- THOMAS HOLLAND CLAGETT, Berryville, Va.
Determination of the Melting Points and Specific Gravities of
Various Alloys of Lead, Tin, and Antimony.
- BENJAMIN IRVIN DRAKE, Chicago, Ill.
Investigation of the Working of Blast Furnace No. 1, of the
Thomas Iron Company, Hokendauqua, Pa.
- STUART RHETT ELLIOTT, Beaufort, S. C.
Investigation of the Various Items of Loss of Zinc in a Spelter
Furnace.

- TELFORD LEWIS, Blairsville.
Investigation of the Working of Blast Furnace No. 1, of the
Thomas Iron Company, Hokendauqua, Pa.
- JAMES GORDON MASON, West Pittston.
Determination of the Calorific Power of Anthracite Coal from the
Mines of the Lehigh Valley Coal Co.
- FRANK STEINMETZ YOUNG, Plymouth Meeting.
Investigation of Tests for the Presence of Gold in Cyanide Solu-
tions.

**FOR THE DEGREE OF BACHELOR OF SCIENCE
(IN MINING).**

- JOHN STEWART, JR., Lonaconing, Md.
A Comparison of the Old and New Methods of Mining in the
George's Creek Basin, Maryland.
- THOMAS CEDWYN THOMAS, Wilkes-Barre.
A Discussion of the Relation of Surface Cracks to Squeezes in
Mining.

FOR THE DEGREE OF ELECTRICAL ENGINEER.

- HARRY LAYFIELD BELL, Norfolk, Va.
(with H. H. Seabrook).
Design and Construction of Field for a d. c. Armature.
- WILLIAM RAGAN BINKLEY, Hagerstown, Md.
(with R. S. Griswold).
Investigation of the Edison Chemical Meter.
- CHARLES SCHWARTZE BOWERS, Philadelphia.
(with L. Diven).
Design of a Three-Phase Alternator.
- WALTER EVERETTE BROWN, Stamford, Conn.
(with O. S. Good).
The Design and Economy of an Electric Lighting Plant for Le-
high University.
- LOUIS DIVEN, Elmira, N. Y.
(with C. S. Bowers).
Design of a Three-Phase Alternator.
- IRA D. FULMER, Richland Centre.
(with A. R. Sterner).
Construction of a Storage Battery of the Planté Type.

- ORRIN SATTERLEE GOOD, Lock Haven.
(with W. E. Brown).
The Design and Economy of an Electric Lighting Plant for Lehigh University.
- RALPH SCOFIELD GRISWOLD, Madison, N. J.
(with W. R. Binkley).
Investigation of the Edison Chemical Meter.
- WILLIAM STEPHEN HIESTER, Harrisburg.
(with H. S. Johnson).
Methods of Control of Street Railway Cars.
- ROSS NATHANIEL HOOD, Duncannon.
Design of a Direct-Connected Dynamo for Lighting.
- ARTHUR PERKINS JENKS, Yardley.
(with C. W. Thorn).
Plans and Specifications for an Electric Railroad between South Bethlehem and Friedensville.
- HARRY SACKETT JOHNSON, East Aurora, N. Y.
(with W. S. Hiester).
Methods of Control of Street Railway Cars.
- CHARLES VICTOR LIVINGSTON, Kingston, N. Y.
(with C. F. Scott).
Design of a Multipolar Railway Generator.
- ARTHUR FROST LOOMIS, Oneida, N. Y.
(with C. P. Nachod).
Tests of Motor Electric Meters.
- BARRY MACNUTT, Bethlehem.
(with H. R. Van Duyne).
Analysis of Coal by Means of X-Rays.
- CARL PIVANY NACHOD, Glenside.
(with A. F. Loomis).
Tests of Motor Electric Meters.
- CHARLES FRANCIS SCOTT, New York City.
(with C. V. Livingston).
Design of a Multipolar Railway Generator.
- HENRY HAMILTON SEABROOK, Beaufort, S. C.
(with H. L. Bell).
Design and Construction of Field for a d. c. Armature.

- ARTHUR HAROLD SERRELL, Plainfield, N. J.
 (with P. B. Straub).
 Tests of Electrically Heated Utensils.
- ALVIN RIEGEL STERNER, Bethlehem.
 (with I. D. Fulmer).
 Construction of a Storage Battery of the Planté Type.
- PAUL BENO STRAUB, Pittsburg.
 (with A. H. Serrell).
 Tests of Electrically Heated Utensils.
- HARRISON RICORD VAN DUYN, Newark, N. J.
 (with B. Mac Nutt).
 Analysis of Coal by means of X-Rays.
- JOHN EUGENE WEIDEMAN, Washington, D. C.
 The Love Electric Railway Conduit System, as installed on the
 Rock Creek Railway, Washington, D. C.
- GEORGE LIVINGSTON YATES, Carlisle.
 Submarine Telephony.

FOR THE DEGREE OF ANALYTICAL CHEMIST.

- BERTINE FREDERIC BORHEK, West Bethlehem.
 Illuminating Gas.
- PATRICK EDWARD DINAN, South Bethlehem.
 The Petroleum Industry.

UNIVERSITY DAY.

This day is the last of the academic year, and falls in 1898 on the third Wednesday in June. On this day orations are delivered by members of the graduating class, and degrees are conferred.

EXERCISES ON JUNE 16, 1897.

MUSIC.

READING OF SCRIPTURE AND PRAYER.

MUSIC.

Salutatory Oration.—“Duties to the State.”

WILLIAM RAGAN BINKLEY.

MUSIC.

Oration.—“Battling the Elements.”

THOMAS CEDWYN THOMAS.

Oration.—“Engineering Science.”

AMBROSE EVERETT YOHN.

MUSIC.

Alumni Address.—“The Relations of the Alumni to the University.”

CASPAR WISTAR HAINES, A. M., C. E., Class of 1874.

MUSIC.

Valedictory Oration.—“Problematical Life and Science.”

WALTER EVERETTE BROWN.

MUSIC.

Award of the Wilbur Scholarship to
EUGENE GIFFORD GRACE, of Goshen, N. J.,
first in rank in the Sophomore Class;
with honorable mention of

ARTHUR WARNER KLEIN, of Bethlehem, and
JOHN WESLEY GRACE, JR., of Goshen, N. J.

The Wilbur Prizes, for excellence in the studies of Freshman year, were awarded as follows:

In Mathematics, to
ALBERT WILLIAM BAYARD, of Washington, D. C., and
LOUIS ORTNER, of Drifton.

In French, to
JOHN FRANCIS BENSON, of Portsmouth, Va.

In German, to
JOHN NICHOLAS REESE, of Harrisburg.

In English, to

JOSEPH WILLIAM BURKE, of Shenandoah, and
JOHN WILLIAM FLETCHER, of Skowhegan, Maine.

In Freehand Drawing, to

THOMAS FRANCIS BELL, of Shenandoah.

In General Chemistry, to

THOMAS WINDLE LUKENS, of Atglen.

Degrees were then conferred by the President of the University upon the candidates whose names appear in the Thesis List, as given above.

THE WILBUR SCHOLARSHIP.

This Scholarship was founded in 1872 by E. P. Wilbur, Esq., of South Bethlehem, and is the sum of \$200 awarded annually to the student in the Sophomore Class having the best record.

THE ALUMNI SCHOLARSHIP FUND.

The Alumni Association of the University has established a Scholarship Fund, for the assistance of worthy students. Such assistance is to be given in the form of loans, secured by notes properly endorsed, subject to the following conditions:

1. That loans from this fund shall be made only to students in need of such help.

2. That help in this form shall not be given during the first year of any student's course; he must without this aid have gone through one year, and must be prepared to start the second year free from all conditions.

3. That help in this form shall not be continued to a student who shall at any time during his course carry any condition over eight weeks beyond the date of the examination in which he failed.

Subject only to the above conditions the disposal of the fund shall until otherwise directed be in the hands of the President of the University.

THE HENRY S. HAINES MEMORIAL SCHOLARSHIP.

Mrs. Henry S. Haines, of Savannah, Ga., has established a scholarship of the annual value of \$200, which is to be devoted to the support at the Lehigh University, throughout his scholastic career, of one student in the School of Mechanical Engineering.

**THE FRED. MERCUR MEMORIAL FUND
SCHOLARSHIPS.**

Friends of the late Frederick Mercur, desiring to establish a memorial of their friendship and esteem, and to perpetuate his memory, have contributed and placed in the hands of the Trustees a fund, to be called "The Fred. Mercur Memorial Fund," sufficient in amount to insure the award of several scholarships for free tuition in the University.

THE ECKLEY B. COXE MEMORIAL FUND.

In memory of the late Eckley B. Coxe, trustee of the University, Mrs. Coxe has established a Fund, amounting to \$20,000, the interest of which is to be used, under the direction of the Trustees of the University, and subject to such regulations as they may adopt, for the assistance of students who without such aid would not be able to meet the cost of living as students of the University.

WILBUR PRIZES.

By the generosity of E. P. Wilbur, Esq., a fund has been established, yielding an annual income of \$100, for distribution in prizes as the Faculty shall determine.

THE PRICE PRIZE FOR ENGLISH COMPOSITION.

Dr. Henry R. Price, an Alumnus and Trustee of the University, has established an annual prize of the value of \$25, to be awarded in June to that member of the Sophomore class who shall write the best essay on a topic in

English Literature assigned by the head of the department of English not later than the beginning of the Second Term in each year.

In estimating the value of all such essays the greatest stress will be laid upon clearness of thought and idiomatic force of expression; and, while looking for correctness of thought put into clear and forcible English, expression will take precedence of ideas in the judgment of the examiner, and for this specific end, greater weight will be given to the form rather than to the matter presented.

Competitors must signify their intent not later than the first of May.

The subject for the prize essay in June, 1898, will be: "A Critical Estimate of the Writings of Thackeray."

ALUMNI PRIZES FOR ORATORY.

The Alumni Association of the University has established an annual sum of Fifty Dollars, to be distributed in prizes for excellence in Oratory, subject to the following

REGULATIONS.

1. The Contest shall be held on the 22d day of February, or on the day designated by the University for commemorating the birthday of Washington.

2. There shall be a first prize of \$25, a second of \$15, and a third of \$10.

3. To entitle one to be a competitor he must be a member of the Junior Class, taking a regular course.

4. Subjects for the orations shall be announced at the beginning of the first term of every year, and upon one of these each competitor shall write an oration not to exceed 1,200 words, taking about eight minutes in delivery.

5. Each oration shall bear upon its first page a fictitious name or motto, and shall be accompanied by a sealed envelope, which shall be superscribed with the same name or motto, and an address by which it may be reclaimed. The envelope shall contain the real name and address of the writer, with the declaration that the oration is his

own original work. The examiner, having adopted a standard of excellence, may reject any or all of the orations presented which do not attain to this standard ; of such as do—should they be sufficient in number—the best six shall be chosen, and their envelopes opened. The others shall be returned to the addresses given, with their envelopes unopened.

6. The Executive Committee of the Alumni Association, or a committee of not fewer than three to be appointed by them, shall hear the competitors whose orations shall have been approved, and the awards shall be made by a majority of these judges.

7. In awarding the prizes the judges shall consider both the literary merits and the delivery of each oration.

8. These rules are subject to amendment by the Faculty.

The annual contest in Oratory for the Alumni Prizes was held on February 22, 1897, with the following competitors :

David Hope Childs, of Towanda.

Herbert Henninger Hess, of Hellertown.

Frank Norman Kneas, of Norristown.

Basil George Kodjbanoff, of Monastir, Macedonia.

Lewis Cheston Starkey, of Bustleton.

The First Prize was awarded to Lewis Cheston Starkey ; the Second to Basil George Kodjbanoff ; the Third to David Hope Childs.

ENTRANCE EXAMINATION PAPERS.

Used for Examinations in 1897.

I.—ENGLISH.

I. GRAMMAR.

1. Correct the following specimens of false syntax and give the reason for each correction :

a. Avoid rude sports : an eye is soon lost, or bone broken. *b.* The place is not mentioned by geographers which wrote at that time. *c.* Those kind of people you will find to be troublesome. *d.* Eve was the fairest of all her daughters. *e.* It is impossible continually to be at work.

2. Define Grammar, English Grammar, Orthography, Etymology, Syntax, and Prosody. Name the ten parts of speech.

3. Define a sentence, a clause, a subordinate clause. Define a noun, a proper noun, a common noun, a collective noun, an abstract noun.

4. Write the entire conjugation of the verb *to be*, naming each mood, tense, number, and person.

5. Analyze the following sentence thoroughly, and parse the words underlined : *I think boys said the school-master when the clock struck twelve that I shall give you a half holiday this afternoon.*

II. RHETORIC.

1. Define Rhetoric, Style, Figure of Speech, Diction, and Composition.

2. Name the essential qualities of a good style. What rules should govern our choice of words ?

3. By what principles should we be guided in the use of new words, colloquial expressions, archaic terms, provincial words, technical words, foreign words ?

4. Define and give an example of each of these : Synecdoche, Metonymy, Simile, Metaphor, Allegory.

5. Give one example of Apostrophe, Hyperbole, Irony, Antithesis, Climax.

6. Write a periodic sentence, a loose sentence, a balanced sentence ; what errors are involved in redundancy, circumlocution, anti-climax ?

III. COMPOSITION.

Write a short piece of descriptive prose, free from errors in punctuation, spelling, and paragraphing, on the subject : The story of Shakespeare's "As You Like It."

II.—UNITED STATES HISTORY.

1. What were the Alien and Sedition Laws, and under whose administration were they passed ?

2. State the principal events of Madison's administration.

3. What is the Monroe Doctrine ? What were the political parties during Monroe's administration and what did each party favor ?

4. Name one of the most remarkable events of the second term of Cleveland's administration and describe the prevalent character of that administration.

5. What were the principal events of Grant's administration ?

6. What exceptional measure was taken at the election of Mr. Hayes ?

II.

7. Is the election of President in strict accord with the spirit of the Constitution ? If not, why ?

8. In what body are the judicial powers of the United States vested ?

9. What provision is made for the amendment of the Constitution ?

10. Where do all bills for raising revenue originate ?

III.—GEOMETRY.

1. Define Geometrical Figure; Ratio of Similitude; Dihedral Angles; Lateral Area; Lune; Angle of two curves; Regular Polyhedron.

2. What are similar cylinders of revolution? When is a line said to be harmonically divided? State difference between *equal figures* and *equivalent figures*.

3. The three perpendiculars from the vertices of a triangle to the opposite sides meet in the same point.

4. An angle formed by a tangent and a chord is measured by one-half the intercepted arc.

5. Three angles of a certain regular polygon are together equal to 5 right angles. How many sides has the polygon?

6. Explain a method of computing π .

7. Prove that the area of a regular inscribed dodecagon is equal to three times the square of the radius.

8. The sum of any two face angles of a trihedral angle is greater than the third.

9. Through a given point to pass a plane tangent to a given cylinder.

10. In two polar triangles, each angle of one is measured by the supplement of the side lying opposite to it in the other.

11. A triangular pyramid has a base of 8 sq. ft. and altitude of 16 ft. At what distance from the vertex must a plane be passed parallel to the base so that the section shall contain 3 square feet?

12. The area of a zone is equal to the product of its altitude by the circumference of a great circle.

IV.—ALGEBRA.

1. When is an equation said to be "satisfied?" What is verifying an equation? What is *elimination by substitution*? How do you get rid of a negative exponent?

2. State difference between *term* and *factor*. Define *geometrical progression* and derive expression for the sum.

III. Simplify

$$(a) \quad \left(\frac{a}{x+a} - \frac{x}{x-a} \right) \div \frac{x^2+a^2}{x^2+ax}.$$

$$(b) \quad \frac{n}{1+x^n} + \frac{n}{1-x^n}.$$

IV. Expand (a) $(2a-3b)^5$. (b) $\frac{1}{\sqrt{1-x^2}}$ to 4 terms.

V. Resolve into factors (a) $x^3+y^3+3xy(x+y)$;

$$(b) \quad x^3 - \frac{4}{x}.$$

VI. Find the square root of $4a^4+9(1-2a)+3a^2(7-4a)$.

VII. Solve

$$(a) \frac{x+3}{x-1} + \frac{x-4}{x-6} = 2. \quad (b) \frac{x-11}{3} + y = 18, \quad 2x + \frac{y-13}{4} = 29.$$

VIII. Find H. C. F. of a^3-2a-4 and a^3-a^2-4 .

Find L. C. M. of x^3+y^3 , $3x^2+2xy-y^2$
and $x^3-x^2y+xy^2$.

IX. The price of photographs is raised \$3.00 per dozen and customers consequently get 10 less than before for \$5.00. What were the prices charged?

X. Find two numbers whose sum is 22, and the difference of whose squares is 250.

XI. Solve $x^6=8+7x^3$.

XII. Find three consecutive numbers such that if they be divided by 10, 17, and 26 respectively, the sum of the quotients will be 10.

V.—PHYSICS.

1. Define: *a*. Gram; *b*. Foot-pound; *c*. Tension of a Gas; *d*. Magnetic Field; *e*. Electrolysis; *f*. Overtone; *g*. Convection of Heat; *h*. Specific Heat; *i*. Principal Focus of a Lens; *j*. Achromatic Lens.

2. A body weighing 100 lbs. rests upon an inclined

plane 10 feet long and one foot high. Represent this weight on paper (letting $\frac{1}{10}$ inch = 10 lbs.) and find, by resolution of forces, what lines represent the pressure on the plane and the force necessary to keep the body from rolling down.

3. State (*a*) Pascal's Law of Liquid Pressure; (*b*) Law of the Screw; (*c*) Laws of the Pendulum.

4. Find the specific gravity and the volume of a piece of brass which weighs 54.00 g. in air and 47.25 g. in water.

5. A current of 0.4 ampere is required in a circuit consisting of a battery, resistance box, and line wire; (*a*) If the resistance of battery and line is 6 ohms and E.M.F. of battery is 10 volts, what resistance must be inserted in the box? (*b*) Calculate the heating effect in joules per minute in the box.

6. Name a unit commonly used for measuring each of the following: (*a*) Energy; (*b*) Heat; (*c*) Difference in Potential; (*d*) Quantity of Electricity; (*e*) Electric Power.

7. Explain the action of a freezing mixture composed of salt and ice.

8. A piece of copper weighing 126 g. is heated up to 98° C. and dropped into 300 g. of water at 20° C. The temperature of the mixture is found to be 23° C. Calculate the specific heat of copper.

9. Explain what sound is and how it travels through air. What is its velocity in air? Name the three characteristics of a musical tone.

10. Explain why grass appears green. Show by a diagram how images are formed by a convex lens and explain how this principle is applied in either a photographic camera or a telescope.

VI.—PHYSICAL GEOGRAPHY.

1. Explain cause of rainbow. Why is it circular in form?

2. What causes tides? Explain spring and neap tides.

3. How do trade winds originate?
4. Explain fully the origin of ocean currents.
5. How are glaciers formed?
6. Describe the phenomena of a thunder shower and explain their cause.
7. What is meant by "erosion" and how may it change the course of a river?

VII.—LATIN.

I. GRAMMAR.

1. Give the genitive plural of *miser*, *lex*; the ablative singular of *portus*, *litus*, *senex*; and the nominative singular of *frigoribus*, *nives*, *sidere*, *tramite*, *rores*.

2. Decline in full *caput*, *movens*, *qui*, *arx*, *domus*, *portus*, *deus*, *dea*, and *duo*.

3. Compare *facilis*, *benevolus*, *bene*, *nequam*, *parvus*, *male*. What is the difference between *decem*, *decimus*, *deni*, and *decies*.

4. Give all the participles of *vereor*; the perfect and supine of *intelligo*, *fundo*, *veho*; the present subjunctive of *volo* and *eo*; the future indicative active of *curro* and *moveo*; and the principal parts of *cado*, *caedo*, *cedo*, *juvo*, *caveo*, *gaudeo*, *fingo*, and *pendo*.

5. State the cases governed by *fungor*, *celo*, *dono*, *rogo*, *impero*, *vescor*, *coram*, *penes*, *propter*, *cupidus*, *patiens*, *praeditus*, *similis*.

6. Mention the various ways of expressing purpose in Latin and translate to illustrate the rules: He sent ambassadors to seek peace.

7. Give the principal parts of the verbs to which the following participles belong: *electus*, *fissus*, *repertus*, *expertus*, *orsus*, *nactus*, *ensus*, *confusus*, *dilectus*, *lotus*.

8. Give the rules for changing the construction from *oratio recta* to *oratio obliqua*.

9. Give the rule for "price" and "place whither," and translate:

(a). He sent an army to Carthage, in Africa.

(b). He sold the slave for three talents.

(c). He values him more every day.

10. What classes of words take the genitive?

II. CAESAR.

Translate :

Quamobrem placuit ei, ut ad Ariovistum legatos mitteret, qui ab eo postularent, uti aliquem locum medium utriusque colloquio diceret : velle sese de republica et summis utriusque rebus cum eo agere. Ei legationi Ariovistus respondit : si quid ipsi a Caesare opus esset, sese ad eum venturum fuisse ; si quid ille se velit, illum ad se venire oportere. Praeterea se neque sine exercitu in eas partes Galliae venire audere, quas Caesar possideret, *neque exercitum sine magno commeatu atque molimento in unum locum contrahere posse. Sibi autem mirum videre, quid in sua Gallia, quam bello vicisset, aut Caesari aut omnino populo Romano negotii esset.*—*B. G., I., 34.*

1. Who was Ariovistus? 2. To whom does *ei* refer (line 1)? 3. What was the occasion of this embassy?
4. Change the words in *ITALICS* to the *oratio recta*.

III. VERGIL.

Translate :

Tempus erat, quo prima quies mortalibus aëgris
Incipit, et dono divum gratissima serpit :
In somnis, ecce, ante oculos maestissimus Hector
Visus adesse mihi, largosque effundere fletus,
Raptatus bigis, ut quondam aterque cruento
Pulvere, perque pedes traiectus lora tumentes.
Hei mihi, qualis erat ! quantum mutatus ab illo
Hectore, qui redit exuvias indutus Achilli,
Vel Danaum Phrygios iaculatus puppibus ignes !
Squalentem barbam et concretos sanguine crines,
Vulneraque illa gerens, quae circum plurima muros
Accepit patrios.

Aen., II., 268-279.

1. Explain the case of *lora* and of *exuvias*.
2. Explain the allusion in *raptatus bigis*.

3. *a.* Divide the last four lines of this passage into feet and mark the rhythmic accent.
- b.* Give the reasons for your divisions.
- c.* When is a syllable in which a short vowel comes before two consonants long, and when is it common?

Translate :

Dixerat. Ille patris magni parere parabat
Imperio ; et primum pedibus talaria nequit
Aurea, quae sublimem alis sive aequora supra
Seu terram rapido pariter cum flamine portant.
Tum virgam capit ; hac animas ille evocat Orco
Pallentis, alias sub Tartara tristia mittit,
Dat somnos adimitque et lumina morte resignat.

Aen., IV., 238-244.

IV. CICERO.

Translate (Cat., II., 6) :

At etiam sunt qui dicant, Quirites, a me in exilium eiectionem esse Catilinam : quod ego si verbo adsequi possem, istos ipsos eiicerem, qui haec loquuntur. Homo enim videlicet timidus aut etiam permodestus vocem consulis ferre non potuit ; simul atque ire in exilium iussus est, paruit : Quid ? ut hesterno die, Quirites, cum domi meae paene interfectus essem, senatum in aedem Iovis Statoris convocavi, rem omnem ad patres conscriptos detuli : quo cum Catilina venisset, quis eum senator appellavit ?

1. Explain the mood and tense of *dicant*, *eiicerem*, *interfectus essem*.
2. Why is the preposition used with *me* (line 1) ?
3. What does *hesterno die* modify ?
4. Why was the temple of Jupiter Stator selected for this meeting of the senate ?

Translate (Cat., IV., 5) :

At vero C. Caesar intelligit legem Semproniam esse de civibus Romanis constitutam, qui autem reipublicae sit hostis, eum civem esse nullo modo posse ; denique ipsum latorem legis Semproniae iniussu populi poenas reipublicae dependisse.

1. Explain the mood of *sit, posse*. 2. What is the antecedent of *qui*? 3. Why are *civem* and *latorem* in the accusative? 4. What mode of punishment did Caesar advise?

V. SIGHT READING.

Translate (Caesar, *B. G.*, *V.*, 53) :

Neque ullum fere totius hiemis tempus sine sollicitudine Caesaris intercessit, quin aliquem de consiliis ac motu Gallorum nuntium acciperet. In his ab Lucio Roscio, quem legioni decimae tertiae praefecerat, certior est factus, magnas Gallorum copias earum civitatum, quae Armoricae appellantur, oppugnandi sui causa convenisse, neque longius milia passuum octo ab hibernis suis afuisse, sed nuntio allato de victoria Caesaris discessisse, adeo ut fugae similis discessus videretur.

Translate (Cicero, *Mil.*, 34) :

Valeant, inquit, valeant cives mei ; sint incolumes, sint florentes, sint beati ; stet haec urbs praeclara mihiq[ue] patria carissima, quoquo modo erit merita de me ; tranquilla re publica mei cives, quoniam mihi cum illis non licet, sine me ipsi, sed propter me tamen perfruantur ; ego cedam atque abibo : si mihi bona re publica frui non licuerit, at carebo mala, et quam primum tetigero bene moratam et liberam civitatem, in ea conquiescam.

VI. COMPOSITION.

Translate into Latin :

1. He asked me to read the letter which he had received. 2. He says that he praises the pupils because they are diligent. 3. We were in Rome the whole winter. 4. I have already repented of my folly. 5. I am afraid the enemy have seized the citadel. 6. Have you heard when they intend to come? 7. They ought to have done that before. 8. I do not know how large a force he had. 9. We will endeavor to take with us all the grain which we now have. 10. Caesar and I pity the poor and we will help them.

VII. HISTORY.

1. Explain the origin and nature of the Tribuneship.
2. Explain the classification of the Roman people and the constitution which was based on this classification.
3. Give the cause, duration, and results of the struggle between Rome and Carthage.
4. What were the internal causes of the weakness of Rome?
5. Give an account of the several Comitia.

VIII.—GREEK.

I.—GRAMMAR.

1. Give the indefinite, demonstrative, and relative adverbs corresponding to the interrogatives *πότε* and *πόθεν*.
2. What is the quantity of the ultima in *σῶμα*, *χώρα*, *ἄνθρωποι*, *ἀγγέλλοι*, and of the penult in *κρίνε*? How is it shown in each case, and what rules are involved?
3. Decline, through all numbers, *δόξα*, *δόδος*, *πατήρ*, *πόλις*.
4. Compare the adjectives *μέγας*, *ἰδύς*, *σοφός*, the adverb *μάλα*.
5. Give the synopsis (*i. e.*, first form in each mode) of the perfect middle, first aorist active, and future active of *φαίνω*. Inflect through the numbers and persons the imperfect active and middle of *τίθημι*, the aorist subjunctive passive of *λύω*.
6. Analyze *λύσουσι*.
7. What prepositions are used with one case only, and with what case respectively?

II.—XENOPHON.

1. Translate :

ἀλλ' ἐγὼ φημι ταῦτα μὲν φλυαρίας εἶναι· δοκεῖ δέ μοι ἄνδρας ἐλθόντας πρὸς Κῦρον οἷτινες ἐπιτήδευοι σὺν Κλεάρχῳ ἐρωτᾶν ἐκείνον τί βούλεται ἡμῖν χρῆσθαι· καὶ ἐὰν μὲν ἢ πρᾶξις ἢ παραπλησία οἴαπερ καὶ πρόσθεν ἐχρήτο τοῖς ξένοις, ἐπεσθαι καὶ ἡμᾶς καὶ μὴ κακίους εἶναι τῶν πρόσθεν τούτῳ συναναβάντων· ἐὰν δὲ

μεζίων ἢ πρᾶξις τῆς πρόσθεν φαίνεται, ἀξιώων ἢ πείσαντα ἡμᾶς ἄγειν ἢ πεισθέντα πρὸς φίλιαν ἀπέναι.—(An. I. 3, 18.)

Construction of *οἷα* and of *πεισθέντα*? On what does *εἰσθαι* depend?

2. Translate :

ταῦτα οὖν φιλοπολέμου μοι δοκεῖ ἀνδρὸς ἔργα εἶναι, ὅστις ἐξόν μὲν εἰρήνην ἔχειν ἄνευ αἰσχύνης καὶ βλάβης αἰρεῖται πολέμεϊν, ἐξὸν δὲ χρήματα ἔχειν ἀκινδύνως αἰρεῖται πολέμων μεῖονα ταῦτα ποιεῖν· ἐκείνος δὲ ὥσπερ εἰς παιδικὰ ἢ εἰς ἄλλην τινὰ ἡδονὴν ἤθελε θάπαναν εἰς πόλεμον.—(An. II. 6, 6.)

Construction of *ἐξόν*? Of whom is this character given?

3. Translate :

τοῦτο δὲ λέγοντος αὐτοῦ πτόρνυται τις· ἀκούσαντες δ' οἱ στρατιῶται πάντες μιᾷ ὁρμῇ προσεκύνησαν τὸν θεόν, καὶ Ξενοφῶν εἶπε, Δοκεῖ μοι, ὦ ἄνδρες, ἕπει περὶ σωτηρίας ἡμῶν λεγόντων, οἷωνός τοῦ Διὸς τοῦ σωτήρος ἐφάνη, εὐξασθαι τῷ θεῷ τούτῳ θύσειν σωτήρια ὅπου ἂν πρῶτον εἰς φίλιαν χώραν ἀφικώμεθα, συνεπύξασθαι· θεὸς καὶ τοῖς ἄλλοις θεοῖς θύσειν κατὰ δόξαν. καὶ ὅτῳ δοκεῖ ταῦτ', ἔφη, ἀνατενέτω τὴν χεῖρα. καὶ ἀνέτειναν ἅπαντες. ἐκ τούτου εὐξάντο καὶ ἐπαιάνισαν.—(An.

III. 2, 9.)

Reason for the subjunctive in *ἀφικώμεθα*? Construction of *ἡμῶν*? Construction of the antecedent of *ὅτῳ*?

4. Translate :

ἐντεῦθεν ἔπειμ' ἄνθρωποις Δημοκράτην Τεμενίτην ἄνδρα δόντες ἐπὶ τὰ ὄρη, ἔνθα ἔφασαν οἱ ἀποσκευάζοντες καθορᾶν τὰ πυρά· οὗτος γὰρ ἐδόκει καὶ πρότερον πολλὰ ἤδη ἀληθεύσαι τοιαῦτα, τὰ ὅντα τε ὡς ὅντα καὶ τὰ μὴ ὅντα ὡς οὐκ ὄντα. πορευθεὶς δὲ τὰ μὲν πυρὰ οὐκ ἔφη ἰδεῖν, ἄνδρα δὲ συλλαβὴν ἦεν ἄγων ἔχοντα τύξον Περσικὸν καὶ φαρέτραν καὶ σάγαριν, οἷανπερ αἱ Ἀμαζόνες ἔχουσιν. ἐρωτώμενος δὲ τὸ ποδαπὸς εἴη, Πέρσης μὲν ἔφη εἶναι, πορεύεσθαι δ' ἀπὸ τοῦ Τιριβάζου στρατεύματος, ὅπως ἐπιτήδεια λάβοι.—(An. IV. 4, 15.)

Construction of *οὗτος*? To what does *τό* belong? Reasons for the optatives *εἴη* and *λάβοι*?

III.—HOMER.

1. Translate :

“Ω πόποι, ἦ μέγα πένθος Ἀχαιῖδα γαῖαν ἰκάνει.
 ἦ κεν γηθήσαι Πριάμος Πριάμοιό τε παῖδες,
 ἄλλοι τε Τρῶες μέγα κεν κεχαροίατο θυμῷ,
 εἰ σφῶν τάδε πάντα πυθοίατο μαρναμένοιιν,
 οἳ περὶ μὲν βουλὴν Δαναῶν, περὶ δ' ἔστ' ἐμάχεσθαι.”

—(Il. I. 254-258.)

Make a list of the forms in these lines peculiar to Homer, adding, in each case, the corresponding Attic form.

Explain the form *κεχαροίατο*.

2. Translate :

“πῇ δὲ συνθεσῆναι τε καὶ ὄρκια βήσεται ἡμῖν;
 ἐν πυρὶ δὲ βουλαί τε γενοίατο μήδεά τ' ἀνδρῶν,
 σπονδαί τ' ἄκρητοι καὶ δεξιαί, ἧς ἐπέπιθμεν.
 αὖτως γάρ ρ' ἐπέεσσ' ἐριδαίνομεν, οὐδέ τι μῆχος
 εὐρέμεναι δυνάμεσθα, πολὺν χρόνον ἐνθάδ' ἔδυντες.”

—(Il. II. 339-343.)

Where is *ἐπέπιθμεν* made? What is the derivation of *σπονδαί*? the reason for the gender of *δεξιαί*? What other forms in Homer of *ἐπέεσσι*? What length of time denoted by *πολὺν χρόνον*?

3. Translate :

ὥς ἄρ' ἔφην, πάλλεν δὲ μέλας κορυθαίολος Ἑκτωρ
 ἄψ ὀρώων. Πάριος δὲ θοῶς ἐκ κληῖρος ὕρουσεν.
 οἱ μὲν ἔπειθ' ἵζοντο κατὰ στίχας ἥχι ἐκάστου
 ἵπποι ἀερσίποδες καὶ ποικίλα τεύχε' ἔκειτο.
 αὐτὰρ ὁ γ' ἄμφ' ὤμοισιν ἐδύσετο τεύχεα καλὰ
 δῖος Ἀλέξανδρος, Ἑλένης πόσις ἠυκόμοιο.
 ὥς δ' αὖτως Μενέλαος ἀρήϊος ἔντε' ἔδυνεν.

—(Il. III. 324-329, 339.)

What was determined by the process described in the first two lines? Why are the words *ἄψ ὀρώων* added? What was the issue of the combat that followed?

IV.—SIGHT READING.

ἐπεὶ δὲ μέγα φρονήσας ὁ Τισσαφέρνης ἐπὶ τῷ καταβάντι στρατεύματι παρὰ βασιλέως προσῆπεν Ἀγησιλάῳ πόλεμον, εἰ μὴ ἀπίοι ἐκ τῆς Ἀσίας, οἱ μὲν ἄλλοι σύμμαχοι καὶ Λακεδαιμονίων οἱ παρόντες μάλα ἀχθεσθέντες φανεροὶ ἐγένοντο, Ἀγησίλαος δὲ μάλα φαιδρῷ τῷ προσώπῳ ἀπαγγεῖλαι Τισσαφέρνει τοὺς πρέσβεις ἐκέλευσεν ὥς πολλὴν χάριν αὐτῷ ἔχει, ὅτι ἐπιорκήσας αὐτὸς μὲν πολεμίους τοὺς θεοὺς ἐκτέσαστο τοῖς δ' Ἕλλησι συμμάχους ἐποίησεν. ἐκ δὲ τούτου εὐθὺς τοῖς μὲν στρατιώταις παρήγγειλε συσκευάζεσθαι ὥς εἰς στρατείαν, ταῖς δὲ πόλεσιν εἰς αἷς ἀνάγκη ἦν ἀφικνεῖσθαι στρατευομένων ἐπὶ Ἡαρίαν προσῆπεν ἀγορὰν παρασκευάζειν.

V.—HISTORY.

1. Give a brief account of Demaratos (the friend of Xerxes) ; of Brasidas ; of Pelopidas.
2. Mention any events you recall between the Persian and Peloponnesian wars.
3. Describe the formation of the first Athenian confederacy and the process of its change into an empire.
4. Describe *ostracism*. Against what individuals is it known to have been put into effect ?

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Louis G. Krause,	M.E.,	Absecon, N. J.
John S. Krauss,	E.E.,	East Greenville.
Samuel Townsend Laubach,	M.E.,	Northampton.
Albert R. Laubenstein,	E.E.,	Ashland.
Adriano T. Lopez,	E.E.,	San Juan, Porto Rico.
Joseph Emanuel McCarthy,	M.E.,	South Bethlehem.
Charles Joseph McGonigle,	C.E.,	Allentown.
George Alexander MacLean,	C.E.,	Bethlehem.
Albert Winfred Mans,	C.E.,	Hazleton.
C. Martinez y Rengifo,	C.E.,	Tampa, Fla.
Luther D. Menough,	C.E.,	York.
Henry Jarvis Moore,	E.M.,	Gill, Mass.
Edward Thomas Murphy,	M.E.,	Brooklyn, N. Y.
Elmer Fellman Musselman,	M.E.,	Middletown.
Harvey S. Musselman,	M.E.,	Steinsburg.
John J. Nolan,	M.E.,	Carbondale.
Harry Edward Packer,	M.E.,	South Bethlehem.
Everett J. Peck,	M.E.,	Plainfield, N. J.
Raymond Thomas Peppell,	M.E.,	Allentown.
Antonio F. de C. Pinheiro,	E.E.,	Pará, Brazil.
John Vincent Rittenhouse,	E.M.,	Plainfield, N. J.
William Perry Rogers,	M.E.,	Latrobe.
Branch Elliott Russell,	C.E.,	Portage, Wis.
James C. Ryan,	E.E.,	Harrisburg.
Albert Clinton Savidge,	E.E.,	Sunbury.
Carlos Nathaniel Scovil,	M.E.,	Copenhagen, N. Y.
John Wallace Shaeffer,	M.E.,	Fleetwood.
Newton Melman Shaffer,	Arch.,	New York City.

	COURSE.	RESIDENCE.
John J. Shonk, jr.,	C.E.,	Plymouth.
Myles Standish Smith,	M.E.,	Mishawaka, Ind.
Constantine Lee Straub,	E.E.,	Bethlehem.
Herman Arnold Straub,	C.E.,	Pittsburg.
Charles Meredith Strawn,	E.E.,	Quakertown.
John Fife Symington,	M.E.,	Baltimore, Md.
Horace A. Taveira,	E.E.,	Havana, Cuba.
Richard Ferrier Taylor,	E.M.,	Bethlehem.
Edward T. Thornton,	E.M.,	Philadelphia.
Grandison G. Underhill,	C.E.,	East Aurora, N. Y.
James Strawbridge Van Alen,	E.E.,	Northumberland.
Joseph Benjamin Varela,	E.E.,	Bethlehem.
Frederick Dana Viehe,	A.C.,	Vincennes, Ind.
Bertil Von Philp,	M.E.,	Bethlehem.
George William Welsh,	E.E.,	Hanover.
John Whitridge,	C.E.,	Baltimore, Md.
Edwin Benton Wilkinson,	A.C.,	Williamsport.
Henry Dalzell Wilson,	M.E.,	Pittsburg.
Robert Augustus Wright,	Sci.,	Allentown.
Thomas Wilbraham Wright,	E.M.,	Philadelphia.
Arthur Reuben Young,	C.E.,	West Bethlehem.

SPECIAL STUDENTS.

	COURSE.	RESIDENCE.
David Maurice Barry,	E.M.,	Agawam, Mass.
Alexander T. Johnson,	E.M.,	Towanda.
Edgar Price,	E.E.,	Berryville, Va.
Walter S. Smith,	E.M.,	Forty Fort.
Harry Wellington Thatcher,	A.C.,	South Bethlehem.

Cuba,	-	-	-	-	-	-	-	-	6
Porto Rico,	-	-	-	-	-	-	-	-	3
British West Indies,	-	-	-	-	-	-	-	-	1
Nicaragua,	-	-	-	-	-	-	-	-	1
Republic of Colombia,	-	-	-	-	-	-	-	-	1
Venezuela,	-	-	-	-	-	-	-	-	2
Brazil,	-	-	-	-	-	-	-	-	2
Ecuador,	-	-	-	-	-	-	-	-	1
France,	-	-	-	-	-	-	-	-	1
Holland,	-	-	-	-	-	-	-	-	1
Macedonia,	-	-	-	-	-	-	-	-	1
Armenia,	-	-	-	-	-	-	-	-	1

SUMMARY OF STUDENTS BY CLASSES AND COURSES.

	GRADUATES.	SENIORS.	JUNIORS.	SOPHOMORES.	FRESHMEN.	SPECIALS.	TOTALS.
Classical,	4	4	1	1	4	1	13
Latin-Scientific,	—	—	—	1	1	—	2
Science and Letters,	2	—	2	2	2	—	8
Civil Engineering,	4	19	18	24	19	—	84
Mechanical Eng.,	1	23	19	31	32	—	106
Mining Eng.,	4	3	4	19	13	3	46
Electrical Eng.,	3	15	10	13	24	1	66
Analytical Chem.,	—	3	7	10	7	1	28
Architecture,	—	—	3	5	2	—	10
	—	—	—	—	—	—	—
Totals,	18	67	12	106	104	5	363

ALUMNI
OF THE
LEHIGH UNIVERSITY.

CLASS OF 1869.

*J. Haynes Hinds Corbin, A.C.

Miles Rock, C.E., Astronomer, Chief Engineer, and President of the Boundary Commission of Guatemala with Mexico, Guatemala City, Central America.

Charles Edward Ronaldson, M.E., Zeta Psi Club, 148 W. 34th Street, New York City; 4017 Locust Street, Philadelphia, Pa.

CLASS OF 1870.

*Lehman Preston Ashmead, A.C., M.D.,

Richard Brodhead, M.E., Attorney-at-Law, 32 Nassau Street, New York City.

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*Harry E. Packer, A.C.

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*William Dunlop Ronaldson, B.A., M.D.

*Deceased.

John M. Thome, C.E., Ph.D., Director National Astronomical Observatory, Cordova, Argentine Republic S. A.

*Russel B. Yates, C.E.

CLASS OF 1871.

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*Charles G. Weaver, C.E.

CLASS OF 1872.

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*F. R. Christian Degenhart, A.C.

Harvey S. Houskeeper, B.A., Principal of State Academy, Brookeville, Md.

*Lentz Edmund Klotz, C.E.

*Deceased.

Oscar Moore Lance, A.C., General Manager, Spring Brook Water Supply Co., Wilkes-Barre, Pa.

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CLASS OF 1873.

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Hildebrando Barjona de Miranda, A.C., Professor of English, Lyceo Paraence, Belém do Pará, Estados Unidos do Brazil.

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CLASS OF 1874.

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CLASS OF 1875.

Charles Julius Bechdolt, C.E., Superintendent Central Division, P., W. & B. R. R., Media, Pa.

Antonio M. Cañadas, A.C., Chemist, Loja, Ecuador.

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Joseph Morrison, C.E., Resident Engineer for Lines west of the Mississippi River, The Wabash Railroad Co. Residence: 401 South Clark Street, Moberly, Mo.

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Edward H. Williams, Jr., B.A. (Yale), A.C., E.M. ('76), F.G.S.A., Professor of Mining and Geology, Lehigh University. Residence: 117 Church Street, Bethlehem, Pa.

* Carl F. Zogbaum, C.E.

CLASS OF 1876.

Frank C. Angle, C.E., Attorney-at-Law, Danville, Montour Co., Pa.

* James DeWitt Carson, C.E.

* Thomas William Frederick, M.E.

William Griffith, C.E., Mining Engineer and Coal Specialist, Coal Exchange, Scranton, Pa. Residence: 405 Susquehanna Avenue, West Pittston, Pa.

* Deceased.

C. William Macfarlane, C.E., Ph.D. (Freiberg i. B. '93),
Narberth, Pa.

Robert W. Mahon, C.E., Ph.D. (Johns Hopkins), Mon-
ongahela Furnace Co., McKeesport, Pa.

J. J. de Gama Malcher, M.E.

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Henry Richards, E.M., Contractor, Dover, N.J.

Lowdon W. Richards, M.E., Columbia, Pa.

Charles L. Taylor, E.M., Assistant to President, The Car-
negie Co., Limited, Carnegie Building, Pittsburg, Pa.

CLASS OF 1877.

John Eagley, C.E., North Springfield, Erie Co., Pa.

Percival D. Giess, C.E., Bethlehem, Pa.

Andrew M. Glassel, C.E., Bowling Green, Va.

George M. Heller, C.E., Bridge Engineer, 853 North
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Henry Sylvester Jacoby, C.E., Associate Professor of
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James Fremont Marsteller, C.E., Superintendent, Snow
Shoe Division, Lehigh Valley Coal Co., Snow Shoe,
Centre Co., Pa.

*Seizo Miyahara, C.E.

Charles R. Rauch, A.C., Central Hotel, Bethlehem, Pa.

Lewis Theodore Wolle, C.E., Secretary of the Cambria
Mining Co., Cambria, Weston Co., Wyoming.

CLASS OF 1878.

Charles Bull, M.E., Assistant Librarian and Bursar, Gen-
eral Theological Seminary, Chelsea Square, New
York City.

*James E. Gilbert, C.E.

William Convers Hazlett, M.E., Architect, 151 Broadway,
New York City.

*Deceased.

Frank Perley Howe, B.A. (Brown), E.M., President, The North Branch Steel Co. ; Vice-President, Wm. Wharton, jr., & Co., Inc. Residence: 251 South 17th Street, Philadelphia, Pa.

Nathaniel Lafon, M.E., Engineer for Jellico & Bird Eye Coal Co., Halsey, Whitley Co., Ky.

Benjamin B. Nostrand, jr., M.E., Electrical Engineer, The Westinghouse Electric and Manufacturing Co. ; Treasurer and Manager, The Sing Sing Electric Lighting Co. ; President and Treasurer, The Peekskill Electric Light and Power Co., Peekskill, N. Y.

Milnor Peck Paret, C.E., Resident Engineer, Kansas City, Pittsburg & Gulf R. R., Lake Charles, La.

Holbrook Fitz John Porter, M.E., General Western Sales Agent for the Bethlehem Iron Co., Room 1433 Marquette Building, Chicago, Ill. Residence: 4214 Berkeley Avenue.

William K. Randolph, C.E.

Robert H. Read, B.A., Successor to Pope, Read and Rogers, Patent Attorneys, 44 Broad Street, New York City.

Henry Church Wilson, C.E., Chief Clerk, U. S. Engineer Office, Room C 8, Army Building, New York City.

CLASS OF 1879.

James S. Cunningham, M.E., Chief Engineer, Berwind-White Coal Mining Co., Tyrone, Pa.

*Joseph Hill Paddock, M.E.

Fitz William Sargent, C.E., General Agent The Sargent Co., 675 Old Colony Building, Chicago, Ill. Residence: The Irving, 308 N. State Street.

Richard Hawley Tucker, C.E., Astronomer, Lick Observatory, Mt. Hamilton, Cal.

CLASS OF 1880.

Abraham Bruner, E.M., Civil Engineer, Assistant Engineer, Norfolk & Western R.R., Crewe, Nottoway Co., Va.

*Deceased.

Murray Morris Duncan, A.C., E.M. ('80), Agent Cleveland-Cliffs Iron Company, Ishpeming, Michigan.

Thomas Hughlett Hardcastle, B.A., M.A. ('82), LL.B., Attorney-at-Law, 601 Boston Building, Denver, Col. Residence: 950 Pearl Street.

John Tinsley Jeter, E.M., Superintendent of the Keystone Coal Co., Wilkes-Barre, Pa. Residence: 222 S. Franklin Street.

Charles Francis King, A.C.

George Ernest Potter, C.E., Assistant Engineer, New York, Chicago & St. Louis R. R., 151 Wayne Street, Fort Wayne, Ind.

Frederick Putnam Spalding, C.E., Assistant Professor of Civil Engineering, Cornell University, Ithaca, N. Y. Residence: 159 E. Seneca Street.

Leonard Blakeslee Treharne, B.A., Editorial Department, *New York Times*, New York City.

Benjamin Russell Van Kirk, M.E., Locomotive Designer, Baldwin Locomotive Works, 2105 Green Street, Philadelphia, Pa.

* Frederick Copeland Wooten, M.E.

CLASS OF 1881.

William Simon Cranz, A.C., Purchasing and Development of Mining Property, Nogales, Arizona.

Alexander Patrick Crilly, B.A., Allentown, Pa.

Thomas Morgan Eynon, M.E., General Manager, The Eynon-Evans Mfg. Co., 15th and Clearfield Streets, Philadelphia, Pa. Residence: 3102 N. Fifteenth Street.

Charles Weed Gray, A.C.

Benjamin Franklin Haldeman, E.M., Superintendent, Bessemer Department, Cambria Iron Co., Johnstown, Pa. Residence: Fayette Street, Westmont, Johnstown.

Lewis Stockton, B.A., Counselor-at-Law, Erie Bank Building, Cor. Niagara and Main Streets, Buffalo, N. Y. Residence: Cor. North and Franklin Streets.

* Deceased.

CLASS OF 1882.

- Louis Oscar Emmerich, E.M., Mining Engineer, Hazleton, Pa.
- Charles Comstock Hopkins, B.S. (Sci.), C.E. ('84), member of firm of The Stanwix Engineering Co., Hydraulic and Sanitary Engineers, Rome, N. Y.
- Elmer Henry Lawall, C.E., General Superintendent Lehigh & Wilkes-Barre Coal Co., Wilkes-Barre, Pa. Residence: 133 S. Franklin Street.
- Robert Thomas Morrow, C.E., Assistant Engineer, Elmira and Canandaigua Divisions, N. C. Ry., Elmira, N. Y. Residence: 702 Park Place.
- Eugene Ricksecker, C.E., U. S. Assistant Engineer in local charge of fortification work, Marrowstone Point, Seattle, Washington.
- John Dougherty Ruff, E.M., 328 South 21st Street, Philadelphia, Pa.
- * Samuel Brenton Sickler, C.E.
- Martin Wittmer, E.M., Superintendent Wittmer Brick Co., Limited, Glen Shaw, Allegheny Co., Pa.

CLASS OF 1883.

- * Enos Kellar Bachman, E.M.
- Walter Briggs, B.A., Attorney-at-Law, Board of Trade Building, Scranton, Pa. Residence: 1505 Adams Avenue.
- Henry Augustus Butler, B.S. (Sci.), Secretary and Treasurer, Carbon Iron and Steel Co., Limited, Mauch Chunk, Pa.
- Hedley Vicars Cooke, B.A., LL.M. (Columbian University), Attorney-at-Law, Union Trust Building, 707 Olive Street, St. Louis, Mo. Residence: Normandy, Mo.
- Francis Joseph Crilly, B.A., M.A. ('89), Special Deputy Collector of the Port, Custom House, Philadelphia. Residence: 1926 Spring Garden Street.
- Francis Wharton Dalrymple, C.E., City Engineer, 131 Main Street, Hornellsville, N. Y.

* Deceased.

- Timothy James Donahoe, A.C., Benson Mines, N. Y.
- George Francis Duck, E.M., General Sales Agent, Port Royal C. & C. Co., 1218 Park Building, Pittsburg, Pa.
- Alfred Edmond Forstall, M.E., General Manager Montclair Gas and Water Co., Montclair, N. J. Residence: 559 Bloomfield Avenue.
- Nathaniel Oliver Goldsmith, M.E., Principal Engineer, The Weir Frog Co.; Vice-President, The We-Fu-Go Co.; Treasurer, The American Coke Drawer Co., Cincinnati, O. Residence: Glendale, O.
- William Théodore Goodnow, C.E., General Manager Cayuta Wheel and Foundry Co., and The Sayre Land and Water Co., Sayre, Pa.
- John Daniel Hoffman, B.A., M.A. ('89), Counselor-at-Law, 17 Broad Street, Bethlehem, Pa. Residence: 30 N. Main Street.
- George Gowen Hood, C.E., Civil Engineer, Mount Airy, Philadelphia, Pa.
- Garrett Linderman Hoppes, C.E., Eagle Hotel, Bethlehem, Pa.
- Julian de Bruyn Kops, B.E. (University of Georgia), C.E., Assistant City Engineer, Savannah, Ga.
- Preston Albert Lambert, B.A., M.A. ('91), Assistant Professor of Mathematics, Lehigh University, South Bethlehem, Pa.
- Edwin Francis Miller, M.E., with R. D. Wood & Co., Camden, N. J.
- Rev. Wilson Franklin More, B.A., M.A. ('91), Pastor Salem Reformed Church, Catasauqua, Pa.
- Nelson Morrow, M.E., Manager of the Deep Rock Mineral Springs, Oswego, N. Y. Residence: 235 West First Street.
- Thomas Nicholson, M.E., with the Johnstown R. R. Frog and Switch Co., Chester, Pa.
- George Spencer Patterson, E.M., Mining and Civil Engineer, Box 131, Terre Haute, Ind. Residence: 521 Ohio Street.

Rembrandt Richard Peale, B.S. (Sci.), Secretary and Treasurer, Bloomington Mining Co., 411-413 Walnut Street, Philadelphia, Pa.

Henry Allebach Porterfield, E.M., President and General Manager, The Dexter Spring and Gear Co., Inc., Pittsburg, Pa. Residence: 319 S. Hiland Avenue, E.E.

Francis Henry Purnell, C.E., E.M. ('86), Clerk of the Circuit Court, Worcester Co., Snow Hill, Md.

Jesse Wilford Reno, E.M., Rapid Transit Tunnel for New York City; The Reno Inclined Elevator Co.; Mining Expert, Mills Building, New York City.

Charles Loomis Rogers, M.E., General Manager, Milton Car Works, Milton, Pa.

John Ruddle, M.E., General Supervisor, Canal Department, The Lehigh Coal and Navigation Co., Mauch Chunk, Pa.

Charles Henry Stinson, B.S. (Sci.), Attorney-at-Law, Norristown, Pa.

* Robert Stinson, B.S. (Sci.).

CLASS OF 1884.

Robert Grier Cooke, B.A., Journalist, with Harper & Brothers, Franklin Square, New York City. Residence: 55 West 36th St.

Henry Bowman Douglas, B.M., E.M. ('85), Consulting Mining Engineer, Vinton Colliery Co., Vintondale, Cambria Co., Pa.

William Banks Foote, B.M., E.M. ('86), Etiwanda, San Bernardino Co., Cal.

Harry Tallman Harper, C.E., Assistant Engineer, Florence & Cripple Creek Railroad, Florence, Col.

Harry Hurd Hillegass, C.E., Civil Engineer, Reading, Pa.

Edwin Franklin Hofford, C.E., Leighton, Pa.

John Andrew Jardine, B.M., E.M. ('85), with Pilling & Crane, Girard Building, Philadelphia, Pa. Mailing Address: Kenvil, Morris Co., N.J.

* Deceased.

- James Warner Kellogg, M.E., Manager of Isolated and Marine Sales, General Electric Co., Schenectady, N.Y.
- David Garrett Kerr, B.M., Edgar Thomson Steel Works, Wilkinsburg, Pa.
- Frederick Bowman Langston, C.E., Architect, 1239 Bedford Avenue, Brooklyn, N.Y.
- William Langston, C.E., with Dean & Westbrook, Bridge Engineers and Contractors, 136 Liberty Street, New York City.
- Robert Packer Linderman, Ph.B., President of the Bethlehem Iron Company; President of the Lehigh Valley National Bank. Residence: South Bethlehem, Pa.
- Joseph Franklin Merkle, C.E. M.D. (Univ. of Pa. '94), Physician and Surgeon, Llewellyn, Pa.
- Harry Krider Myers, C.E., general engineering, 3653 North 15th Street, Philadelphia, Pa.
- Albino Rosendo Nuncio, M.E., 3d Officer of the Section of Agriculture and Patents of the Secretary of Fomento, City of Mexico, Mexico.
- James Ward Packard, M.E., President, The Packard Electric Co., Manufacturers, Warren, O.
- Alfred Scull Reeves, B.M., E.M. ('85), of the firm of Paul S. Reeves & Son, Manufacturers of Phosphor Bronze, Brass, Babbitt Metals, etc., 1415-1425 Catharine Street, Philadelphia, Pa. Residence: 21st Street and Delancey Place.
- Barry Searle, A.C., Superintendent Deep Crown Gold Mine, Johannesburg, South African Republic. Permanent address: care of R. S. Searle, Montrose, Pa.
- Lewis Buckley Semple, B.A., M.A. ('91), Ph.D. (Princeton), Instructor in English, Lehigh University.
- Augustus Parker Smith, M.E., LL.B. (Georgetown Univ.), Counselor-at-Law; specialty, Patent and Copyright Cases; 45 Broadway, New York City. Residence: 336 West 55th Street.
- Murray Stewart, M.E., Motive-Power Department, Philadelphia, Wilmington & Baltimore R. R. Co., Wilmington, Del.

Richard Washington Walker, C.E., Glen Moore, Pa.
James Angus Watson, C.E., Patent Lawyer, 931 F Street,
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CLASS OF 1885.

Warren Howard Allen, A.C., Clerk, Farmers' National
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Harry Luther Bowman, B.M., care of Y. M. C. A., Har-
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William Noble Edson, C.E., of the firm of Edson Brothers,
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* John Roberts Engelbert, C.E.

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* Elliot Otis Smith, C.E.

Clarence Moncure Tolman, M.E., Mechanical and Elec-
trical Engineer, with Edward G. Stoiber, Silver Lake
Mines, Silverton, Col.

John R. Wagner, M.E., Superintendent of Motive Power,
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Cabell Whitehead, B.M., M.S. (Columbian University), Assayer, Bureau of the Mint, Treasury Department, Washington, D. C. Residence: 1114 New Hampshire Avenue.

CLASS OF 1886.

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- Solomon Jacob Harwi, C.E., Assistant Engineer, Marine Department, The Babcock and Wilcox Co., New York City. Residence: 38 West 33d Street, Bayonne, N. J.
- Simeon Cole Hazelton, B.M., E.M. ('87), Assistant Superintendent, Germania Lead Works, Murray, Utah.
- Mark Antony De Wolfe Howe, jr., B.A., A.B. and A.M. (Harvard), Bristol, R. I.
- Charles Alexander Junken, C.E., Computer on Gun Construction, Ordnance Office, War Department, Washington, D. C. Residence: 435 New Jersey Avenue, S. E.
- Guadalupe Lopez de Lara, M.E., Principal in the Lopez de Lara Iron Works Co., Guadalajara, Jalisco, Mexico. Residence: Avenida Alcalde No. 8.
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- Henry Gerber Reist, M.E., Mechanical and Electrical Engineer, with General Electric Co., Schenectady, N. Y. Residence: 5 South Church Street.
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- George Mann Richardson, A.C., Ph.D. (Johns Hopkins), Professor of Organic Chemistry. Leland Stanford, Jr., University, Stanford University, Cal.
- *Augustus Stoughton Ross, M.E.

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CLASS OF 1889.

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- William Calvin Shoemaker, C.E., Assistant Superintendent, Dayton and Michigan Division, C. H. & D. Ry., Lima, Ohio.
- Michael Druck Sohon, A.C., M.S. ('95), Ph.D. (Johns Hopkins), in charge of Department of Chemistry, High School, 3080 Third Avenue, New York City.

- William Alston Stevenson, M.E., Superintendent, Stearns Mfg. Co., Engine, Boiler, and General Machine Builders, Erie, Pa. Residence: 225 W. 11th Street.
- Theodore Alfred Straub, C.E., Vice-President and General Manager, Fort Pitt Bridge Works, Pittsburg, Pa. Residence: 4921 Forbes Street.
- Francis du Pont Thomson, M.E., Edgar Thomson Steel Works, Braddock, Pa. Residence: 4737 Bayard Street, Pittsburg, Pa.
- Charles Cookman Tomkinson, M.E., Chief Draftsman for Stearns Mfg. Co., 329 W. Fifth Street, Erie, Pa.
- Claude Allen Porter Turner, C.E., Assistant Engineer, Gillette-Herzog Manufacturing Co., Minneapolis, Minn.
- Aaron Howell Van Cleve, C.E., Office Assistant, in charge of Drafting-room, Cataract Construction Co., Echota, Niagara Falls, N. Y.
- José Ramon Villalon y Sanchez, C.E., Santiago de Cuba, Isle de Cuba.
- Samuel Dexter Warriner, B.A. (Amherst), B.S., E.M. ('90), Superintendent Calumet & Hecla Mining Co., Calumet, Mich.
- David Thomas Williams, M.E., Draftsman, Bethlehem Iron Co. Residence: Catasauqua, Pa.
- Herbert Wright, M.E., Assistant Examiner, U. S. Patent Office, Washington, D. C.

CLASS OF 1891.

- Murray Blachly Augur, E.E., Train Master, Buffalo Division, Lehigh Valley Railroad, Buffalo, N. Y.
- James Edwin Boatrite, B.A. (S. W. Presb. Univ.), C.E., *World Building*, New York City.
- J. W. Boyd, C.E., Division Engineer, Coal Department, Delaware and Hudson Canal Co., Room 25, D. & H. C. Co. Depot, Scranton, Pa.
- John Emery Bucher, A.C., Ph.D. (Johns Hopkins), Assistant Professor of Chemistry, Rhode Island College of Agriculture and Mechanic Arts, Kingston, R. I.

- Jacob Burr Buckley, E.E., Carpenter and Builder, Oxford, N.Y.
- Emanuel Chao, C.E., Cienfuegos, Cuba.
- Edward Haviland Coxe, C.E., Mining Engineer, Sunday Creek Coal Co., Corning, Perry Co., O.
- Warder Cresson, M.E., with Lehigh Valley Railroad Co., Swarthmore, Delaware Co., Pa.
- John Rose Davis, C.E., Assistant Engineer, Erie R. R., Port Jervis, N.Y.
- Eric Doolittle, C.E., Flower Observatory, Upper Darby P. O., Philadelphia, Pa.
- Alban Eavenson, A.C., Chemist, J. Eavenson & Sons, 313 N. Twentieth St., Philadelphia, Pa. Residence: 2013 Vine Street.
- Juan de la Cruz Escobar, M.E., Mechanical Engineer and Contractor, Matanzas, Cuba.
- Walton Forstall, E.E., Superintendent, Lockport Gas and Electric Light Company, Transit and LaGrange Sts., Lockport, N.Y.
- John Stillwell Griggs, jr., M.E., Consulting Mechanical and Electrical Engineer, 99 Cedar Street, New York City. Residence: 38 Lenox Road, Brooklyn.
- George Samuel Hayes, C.E., Engineer for the Tostevin-Hayes Fireproof Construction Co., 1123 Broadway, New York City. Residence: 129 W. Thirteenth St.
- John Sidney Heilig, M.E., Secretary and Treasurer, Lenox Mfg. Co., manufacturers of sewing machine attachments, Allentown, Pa. Residence: 529 Allen St.
- William Albert Heindle, C.E., with E. Saxton, Contractor, Washington, D. C. Residence: 251 North High St., Baltimore, Md.
- John Franklin Hersh, C.E., Hardware Merchant, 825 Hamilton Street, Allentown, Pa.
- Hermann Victor Hesse, B.S., E.M. ('92), Lehigh Valley Coal Co., Lost Creek, Pa.
- Paul Depue Honeyman, E.E., Chief Foreman, Underground and Central Office, The Metropolitan Telephone and Telegraph Co., 18 Cortlandt St., New York City.

- John Turner Hoover, B.S. (in Architecture), Philipsburg, Pa.
- Hagime Ichikawa, A.C., Imperial Printing Bureau, Tokio, Japan.
- Albert Edward Juhler, A. C., Chemist, Standard Oil Co., Olean, N.Y. Residence: 163 Fourth Street.
- Henry Kemmerling, C.E., Teaching, 2623 Main Avenue, Scranton, Pa.
- Herman Meriwether Knapp, C.E., Contracting Engineer for the Pittsburg Bridge Company, American National Bank Building, Louisville, Ky.
- Rev. Frederic Curtiss Lauderburn, B.A., Rector Calvary Protestant Episcopal Church, Tamaqua, Pa.
- Charles McKnight Leoser, B.S., E.M. ('92), Publisher *Bonfort's Wine and Spirit Circular*, 34 Beaver Street, New York City. Residence: Hotel Endicott, 81st Street and Columbus Avenue, New York City.
- James Anderson McClurg, B.S. (in Metallurgy), Estimating Department of Keystone Bridge Works, 51st Street, Pittsburg, Pa. Residence: Sewickley.
- Frank Anderson Merrick, E.E., with Blood and Hale, Consulting Engineers, 305 Equitable Building, Boston, Mass.
- John Zollinger Miller, E.E., Manager and Superintendent of the Mutual Telephone Co., Room 32, Downing Building, Erie, Pa.
- Harry Timothy Morris, M.E., in charge of Plate and Universal Mills, Bethlehem Iron Co., South Bethlehem, Pa. Residence: P.O. Building, Bethlehem.
- Paul Mayo Paine, C.E., Associate Editor *The Post*, Syracuse, N.Y. Residence: 101 White St.
- Edwin Adams Quier, A.C., Secretary, Reading Fire Brick Works, Reading, Pa. Residence: 302 South Fifth Street.
- Walter Freeman Rensch, C.E., Assistant Supervisor, P. R. R., St. Mary's, Pa. Residence: Commercial Hotel.
- Robert Schmitz, C.E., United States Surveyor, U. S. Engineer Office, Lock Box 812, Philadelphia, Pa.

- Ellis Anstett Schnabel, B.A., M.A. ('93), Assistant Professor of Latin and Greek, Central High School, Broad and Green Streets, Philadelphia, Pa. Residence: 216 DeKalb Square, West Philadelphia, Pa.
- Leidy Rudy Shellenberger, C.E., Assistant Engineer with Pencoyd Iron Works. Residence: 215 Rochelle Avenue, Wissahickon, Philadelphia, Pa.
- Ira Augustus Shimer, B.A., M.D. (Univ. Pa., '97), Resident Physician, St. Luke's Hospital, South Bethlehem, Pa.
- Horace Theodore Stilson, C.E., 40 Church Street, Winchester, Mass.
- R. Paul Stout, M.E., General Foreman, Armor Plate Department, Bethlehem Iron Company, South Bethlehem, Pa. Residence: 332 Market Street, Bethlehem.
- James Edward Talmage, A.C., D.Sc.D., Ph.D., F.R.M.S., F.R.S. (Edin.), F.G.S., Professor of Geology, University of Utah, Salt Lake City, Utah.
- William Sidney Topping, B.S. (Lat. Sci.), Ph.G., Druggist, Main Street, East Islip, N. Y.
- Domingo Anthony Usina, C.E., Assistant Examiner of Patents, Room 32, Patent Office, Washington, D. C. Residence: 409 Fifteenth Street, N. W.
- Elias Vander Horst, C.E., with W. R. Fleming & Co., 620 Atlantic Avenue, Boston, Mass.
- George Edward Wendle, E.E., Lycoming Electric Co., Williamsport, Pa.
- Peyton Brown Winfree, C.E., City Engineer, Bradford, Pa.

CLASS OF 1892.

- Rev. William North Robins Ashmead, B.A., Missionary, St. John's P. E. Mission, Westfield, Tioga Co., Pa.
- * George W. B. Asmussen, C.E.
- Robert Ligget Baird, C.E., Engineer Corps, P. R. R., Mifflintown, Pa.
- Joseph Barrell, B.S., E.M. ('93), M.S. ('97), Assistant Engineer, Butte & Boston Consolidated Mining Co., Butte, Mont. Address: P. O. Box 1172.

* Deceased.

- John Young Bassell, jr., B.S., E.M. ('95), Hotel Chittenden, Columbus, O.
- John Newbaker Bastress, C.E., Assistant Engineer, Berlin Iron Bridge, East Berlin, Conn.
- John Mayall Beaumont, M.E., 125 South Seventh Street, Scranton, Pa.
- William Williams Blunt, E.E., Engineer, Westinghouse Electric Co., Limited, 32 Victoria Street, London, S. W., England.
- William Young Brady, B.S. (in Architecture), studying in Europe; will reside at Pittsburg, Pa.
- Charles Merritt Case, B.S., E.M. ('93), Treasurer Royal Elevator Co., grain dealers, 55 Chamber of Commerce Building, Minneapolis, Minn.
- George Price Case, B.S., E.M. ('93), Grain, 26 Chamber of Commerce, Minneapolis, Minn. Residence: The Swinburne.
- Philip Lothrop Cobb, C.E., 2509 Euclid Avenue, Cleveland, O.
- Frederick Albert Coleman, C.E., Hydraulic and Sanitary Engineer, Rome, N. Y.
- Samuel Dewey Cushing, M.E., Asst. Supt. Binghamton General Electric Co., 79 State Street, Binghamton, N. Y. Residence: 52 Main Street.
- Herman Haupt Davis, M.E., General Manager of the Galisteo Mining Co., Cerrillos, New Mexico.
- Morgan Davis, jr., B.S. (in Mining), General Superintendent Elk Hill Coal and Iron Co., Scranton, Pa.
- William Russell Davis, C.E., 1455 Washington Avenue, New York City.
- Heber Denman, B.S. (in Mining), Assistant Engineer, Berwind-White Coal Mining Co., Scalp Level, Cambria Co., Pa.
- Edwin Dodge, B.S. (in Metallurgy), Gouverneur, N. Y.
- Percival Drayton, M.E., Superintendent Blooming and Continuous Bar Mills, Apollo Iron and Steel Co., Vandergrift, Westmoreland Co., Pa.
- *Harry S. Eckert, A.C.

* Deceased.

Lester Hallett Ely, A.C., care of Coxe Brothers and Company, 143 Liberty Street, New York City. Residence: 26 East Third Street, Bayonne, N. J.

George Washington Engel, B.S., E.M. ('93), Assistant Engineer, Lehigh Coal and Navigation Co., Lansford, Pa.

Thanlow Gjertsen, C.E., Engineer in charge, Clinton Cement Co., Pittsburg, Pa. Permanent address: Saxton, Pa.

*John Adams Gruver, B.A.

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Robert Reed Kitchel, C.E., with E. D. Leavitt, Mechanical Engineer, Cambridgeport, Mass.

Sylvester Welch Labrot, C.E. Assistant Engineer, L. & N. R. R., Chief Engineer's Office, Louisville, Ky.

Henry Lefevre, B.S., E.M. ('93), Asst. Engineer, Playa de Oro Gold Mining Co., Playa de Oro, Ecuador. Permanent address: care Henry Lefevre, Panama, Republic of Colombia, South America.

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- Raymond S. Masson, E.E., District Engineer, Westinghouse Electric & Manufacturing Co., Mills Building, San Francisco, Cal.
- Edward James Millar, C.E., Civil and Sanitary Engineer, 19 Masonic Temple, Wheeling, W. Va.
- Charles Tyler Mosman, E.E., Power and Mining Engineering Department, General Electric Co., Schenectady, N. Y. Residence: 406 Union Street.
- Robert Blum Olney, C.E., Acting Engineer, Sewerage Department, Charleston, S. C. Residence: 139 St. Philip Street.
- Henry Orth, jr., B.S., E.M. ('93), Patent Attorney, 1011 L Street, N. W., Washington, D. C.
- Ramon Eckhart Ozias, B.S. (in Metallurgy), Assayer, U. S. Laboratory, New York City. Permanent address: Quakertown, Pa.
- Frank DeWitt Randolph, M.E., Head Draftsman, C. Potter, jr., & Co., Manufacturers of Printing Presses, 444 West Front Street, Plainfield, N. J.
- Robert Swenk Rathbun, C.E., Manager Lehigh Engineering Co., 5 Paxson Building, Allentown, Pa. Residence: 11 North 10th Street,
- Samuel Arthur Rhodes, E.E., Engineering Department, Chicago Telephone Co., Chicago, Ill. Residence: 429 North Pine Avenue, Austin, Ill.
- John Ira Riegel, C.E., Assistant Engineer, Easton and Amboy Division, Lehigh Valley R. R. Residence: 439 Cherokee Street, South Bethlehem, Pa.
- Anton Schneider, C.E., Assistant Engineer, Oregon Short Line R. R., Salt Lake City, Utah.
- John Bonner Semple, A.C., Secretary of Sterling Varnish Co., 325 Water Street, Pittsburg, Pa. Residence: Sewickley.

- Cass Knight Shelby, M.E., Motive Power Department, P. R. R., Altoona, Pa. Address: P. O. Box 314.
- James Causten Shriver, C.E., Civil Engineer, 4 Water Street, Cumberland, Md.
- Philip Henry Waddell Smith, E.E., Assistant General Manager of Standard Underground Cable Co., Westinghouse Building, Pittsburg, Pa. Residence: 6730 McPherson Street.
- Michael Neligan Usina, E.E., Engineer of Tug "Bristol," Savannah, Ga. Residence: 401 Waldburg St., West.
- Lester Warren Walker, E.E., Electrical Contractor, Savannah, Ga. Residence: 321 Congress Street, West.
- David Heikes Witmer, C.E., Assistant Engineer, American Pipe Manufacturing Co., 112 North Broad Street, Philadelphia, Pa.
- Frederic Wittman, A.C., Lanark, Pa.
- Charles Oaks Woods, M.E., with T. B. Woods' Sons, Manufacturers of Machinery for the Transmission of Power, Chambersburg, Pa.
- Byron Edgar Woodcock, C.E., with the California Eastern Railway Co., 132 Stimson Block, Los Angeles, Cal.

CLASS OF 1893.

- George Haldeman Atkins, C.E., Pottsville, Pa.
- Harry Jacobs Atticks, E.E., Lisburn, Pa.
- Hugh Cunningham Banks, C.E., General Engineering, Room 344 Equitable Building, Atlanta, Ga.
- Noble C. Banks, B.S. (in Metallurgy), Acting General Manager, Valley View Gold Mining Co., Telluride, Col. Permanent address: care of John T. Graham, Esq., 604 Equitable Building, Denver, Col.
- Herman Renner Bickler, C.E., Secretary and Chief Engineer, Fort Pitt Bridge Works, Pittsburg, Pa.
- William Irvin Boyd, C.E., District Engineer's Office, No. 70 I Street, N. E., Washington, D. C.
- Frederick Edgar Bray, C.E., Structural Draftsman, Carnegie Steel Co., Limited, 1420 Carnegie Building Pittsburg, Pa. Residence: 227 Fisk Street.

Gilbert Forbes Burnett, B.S. (Sci.), Teaching, Mountain View, N. J. Permanent address: New Providence, N. J.

George Edwin Chamberlain, A.C., Chemist for the Glucose Sugar Refining Company, Chicago, Ill.

Warren Fellman Cressman, C.E., Sellersville, Pa.

Rev. Walter Joseph Dech, B.A., Pastor of New Salem Church, Danielsville, Pa.

Charles Malcolm Douglas, B.A., General Theological Seminary, Chelsea Square, New York City.

Charles Hazard Durfee, E.E., Insurance and Real Estate Broker, Treasurer People's Coöperative Bank, 60 Bedford Street, Fall River, Mass. Residence: 807 High Street.

Bernard Enright, A.C., Assistant Chief Chemist, Bethlehem Iron Company, South Bethlehem, Pa. Residence: 330 E. Fourth Street.

Henry Brown Evans, M.E., Instructor in Astronomy, University of Pennsylvania. Address: Flower Observatory, Upper Darby, Delaware Co., Pa.

George Harwood Frost, M.E., B.A. Sc. (McGill Univ., '96), with Frost & Wood, Manufacturers of Agricultural Machinery, Smith's Falls, Ontario, Canada.

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Robert Foster Gadd, C.E., Estimating Department, Levering & Garrigues, 552-554 West 23d Street, New York City. Residence: 63 West 50th Street. Permanent address: Sudlersville, Md.

Charles Willits Gearhart, E.E., Electrician, New York and Brooklyn Bridge, 403 3d Street, Brooklyn, N.Y.

Harvey Hartzell Godshall, A.C., of the firm of A. C. Godshall & Co., Millers, Lansdale, Pa.

Samuel Laury Graham, A.C., Analytical Chemist and Assayist, Rome Testing Laboratory, Rome, Ga.

Lee Stout Harris, C.E., Civil, Mining, and Electrical Engineer, for Pulaski Iron Co., Eckman, W. Va.

Claude Sanford Haynes, C.E., Assistant City Engineer,
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son Street.

Richard Willis Heard, E.E., Swissvale, Pa.

Robert Culbertson Hays Heck, M.E., Instructor in Me-
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hem, Pa.

Charles Lincoln Keller, M.E., with the Scherzer Rolling
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Schuyler Brush Knox, C.E., with Berlin Iron Bridge Co.,
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Frank Sigismund Loeb, A.C., Manufacturing Chemist,
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Hiram Dryer McCaskey, B.S. (in Mining), Head Master,
St. Thomas Hall, Holly Springs, Miss.

Charles Louis McKenzie, C.E., with the Shiffler Bridge
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William Price Marr, E.E., Superintendent, Shamokin &
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Archibald Stewart Maurice, C.E., Athens, Pa.

George Holbrooke Maurice, C.E., Athens, Pa.

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- chanic of the Montour Rolling Mills Department of the Reading Iron Co., Danville, Pa.
- John Gates Peck, C.E., care of Milliken Brothers, 39 Cortlandt Street, New York City. Residence: 12 East 32d Street, Bayonne, N.J.
- Raymond Bernard Fitz Randolph, A.C., Bacteriologist, Brooklyn Health Department, Hoagland Laboratory, Henry and Pacific Streets, Brooklyn, N.Y.
- John Graham Reid, C.E., Chief of Surveys, Union Trac-tion Co., Philadelphia, Pa. Residence: 2412 Stanley Street.
- Edwin Clark Reynolds, C.E., Topographer, U. S. Survey for Deep Waterways, Cohoes, N.Y. Residence: 87 Mohawk Street. Permanent address: Station E, Washington, D. C.
- Francis Evans Richards, C.E., Cobbs Switch, Lowndes Co., Miss.
- George William Ritchey, B.S. (Lat. Sci.), 26 Bluff Street, Pittsburg, Pa.
- Frederick Brittan Sage, E.E., Hackensack, N.J.
- Martin Luther Saulsbury, C.E., Civil Engineer, Westfield, N.J.
- Joseph A. Schloss, A.C., Chief Chemist, La Gran Fun-dicion Nacional Mexicana, Monterey, Mexico.
- Armin Schotte, C.E., care of Riter and Conley, Allegheny, Pa. Residence: 237 Fisk Street, Pittsburg, Pa.
- William Frederick Semper, A.C, Chemist, Haskel & Barker Car Co., 832 Pine Street, Michigan City, Ind.
- Alexander Betty Sharp, B.S. (in Metallurgy), General Manager, W. L. Sharp & Son, manufacturing fire-place goods, Steubenville, O.
- Noel W. Smith, C.E., Assistant Supervisor N. C. Ry., York, Pa. Residence: 26 East Philadelphia Street.
- Edward Augustus Soleliac, B.S. (in Metallurgy), Assistant Superintendent Adelaide Silk Mills, Allentown, Pa. Residence: 132 North 4th Street.
- George Stern, B.A., Attorney-at-Law, Philadelphia, Pa. Permanent address: Frostburg, Md.

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CLASS OF 1894.

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William Conklin Anderson, E.E., Superintendent at Red Bank, N. J., for the Consolidated Gas Company of New Jersey. Residence: Riverside Avenue, Red Bank.

George Washington Scott Baton, B.S. (in Mining), Division Engineer with H. C. Frick Coke Co., Scott-dale, Pa.

Irvin Isaac Beinhower, M.E., Draftsman, Lincoln Iron Works, Rutland, Vt. Residence: Brock House.

Thomas Joseph Bray, jr., M.E., Secretary and Mechanical Engineer, McGill & Co., Engineers and Machinists, 27th and Smallman Sts., Pittsburg, Pa.

Lawrence Calvin Brink, C.E., 166 West 126th Street, New York City. Employed by N.Y.C. & H.R.R.R. Co.

Rezeau Blanchard Brown, M.E., Works Superintendent, Market Street Gas Works, Newark, N.J.

Emott Davis Buel, C.E., Chief of Hydrographical Party, U.S. Army Engineer Corps, Hudson River Improvement, 51 State Street, Albany, N.Y. Residence: 21 South Hawk Street.

- James Lindsey Burley, C.E., Civil Engineer, associated with Nathan F. Barrett, Landscape Architect, 50 Wall St., New York City. Residence: 19 West 38th St.
- William Colwell Carnell, A.C., Chemist, Nelson Morris & Co., U.S. Yards, Chicago, Ill. Residence: 3232 Wabash Avenue.
- Thomas Francis Carroll, B.S. (Latin Sci.), 166 York Street, New Haven, Conn.
- Alden Brown Diven, C.E., with the La France Fire Engine Co., Elmira, N. Y. Residence: 957 Lake St.
- Walter Jules Douglas, C.E., Engineer with L. V. Coal Co., Hazleton, Pa.
- Walter Sewell Dunscomb, C. E., Draftsman, Building Division, Carnegie Steel Co., Pittsburg, Pa. Residence: Oakmont, Pa.
- Thaddeus Percival Elmore, C.E., Assistant Manager, Havana Bridge Works, Montour Falls, N. Y. Permanent address: 109 W. Chemung Place, Elmira, N. Y.
- Theodore Gwathmey Empie, E.E., Engineering Department, N.Y. and N.J. Telephone Co., 16 Smith Street, Brooklyn, N.Y.
- Frank Faust, E.E., Draftsman, with The Jackson & Woodin Mfg. Co., Berwick, Pa.
- James DuBose Ferguson, C.E., in charge of Engineer Corps, making right-of-way survey, Belvidere Division, P. R. R., Lock Box 78, Phillipsburg, N. J. Permanent address: Office of Broad Street Station, Penna. R. R., Philadelphia, Pa.
- Robert Ferriday, C.E., Assistant on Engineering Corps, E. & A. Division, Pennsylvania Co., Lawrence Junction, Pa. Residence: 72 North Street, New Castle, Pa.
- Richard Daniel Floyd, A.C., Manager Floyd Bros. & Co., Converters of Cotton Goods, 187-189 Market Street, Chicago, Ill. Residence: 5426 Jefferson Avenue.
- John Jacob Frank, E.E., General Electric Co., Schenectady, N. Y. Residence: 442 State Street.
- Luther L. Gadd, E.E., Estimating Department, Levering and Garrigues, 552-554 West 23d Street, New York City. Residence: 63 West 50th Street.

- Frank Wieseman Glading, M.A. (Phila. Central High School), M.E., M.S. (Cornell), Electrician for the Edison Manufacturing Co., Orange, N. J. Residence: West Orange. Permanent address: 2005 East York Street, Philadelphia, Pa.
- Milton Brayton Graff, A.C., Asst. Chemist for Proctor & Gamble Co., Ivorydale, O. Residence: Forest Avenue, Avondale, Cincinnati, O.
- Elwood Aristides Grissinger, E.E., Electrical Engineer and Salesman, Westinghouse Electric and Manufacturing Co., Syracuse, N. Y.
- Bayard Guthrie, M. E., Superintendent, A.M. Guthrie & Co., 21st and Smallman Streets, Pittsburg, Pa. Residence: 5978 Alder Street, E.E.
- William McCleery Hall, M.A. (Franklin & Marshall), C.E., Assistant Master, Yeates Institute, Lancaster, Pa. Residence: 30 West King Street.
- Fletcher Dickerman Hallock, E.E., Electrical Engineering, No. 308 West 5th Street, Plainfield, N. J.
- Arthur Williston Henshaw, E.E., Engineering Department, General Electric Co., Schenectady, N. Y. Residence: 8 Union Street.
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- Matthew McClung, jr., B.S. (in Metallurgy), Chemist, Carrie Furnace Co., Rankin, Pa.
- John Douglas McPherson, E.E., 1240 19th Street, N. W., Washington, D. C.
- John Van Sickle Martenis, M.E., with Terminal R. R. of the B. W. & W. Co., Pier 8, Robert Stores, Brooklyn, N. Y. Residence: 464 9th Street.
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- William Bailey Taylor, E.E., Electrician, in charge of Telephone Exchange, Rochester Telephone Co., Rochester, Minn. Permanent address: 81 Market Street, Bethlehem, Pa.
- John Augustus Thomson, B.S., E.M. ('97), Summit Point, W. Va.
- Edward Coppée Thurston, B.S. (in Metallurgy), Student: School of Mines, Freiberg, Saxony, Germany.
- Joseph Wharton Thurston, B.A., Physical Laboratory, Bethlehem Iron Co., South Bethlehem, Pa. Residence: 311 Cherokee Street.
- Curtis Edwards Trafton, E.E., 90 Franklin Street, Fall River, Mass.
- Harry Conklin Tripp, M.E., with the General Electric Co., Schenectady, N. Y. Permanent address: Milerton, N. Y.
- John Scofield Wallace, B.S. (in Metallurgy), New Castle, Pa.
- Ulysses Grant S. Walters, C.E., Pottstown, Pa.

* Deceased.

- Harry Dallam Webster, M.E., Draftsman, Dickson Locomotive Works, Scranton, Pa. Residence: 636 Adams Avenue.
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- Davis Sanno Williams, B.S. (in Architecture), Fort Snelling, Minn.
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- Alfred Mahlon Worstall, E.E., Manager for G. S. W. Brubaker, Contracting Engineer, Newtown, Pa.

CLASS OF 1897.

- Francis DuPont Ammen, M.E., with the Harlan and Hollingsworth Co., Shipbuilders, Wilmington, Del.
- Henry Jonathan Biddle Baird, B.S. (in Metallurgy), with the Orford Copper Co., Constable Hook, N. J. Residence: 100 Avenue D, Bayonne, N. J.
- Lathrop Hutchings Baldwin, M.E., with the Ingersoll-Sergeant Rock-Drill Co., Easton, Pa. Residence: 155 Bushkill Street.
- Charles Marshall Barton, C.E., with L. V. R. R. Engineer Corps, Waterloo, N. Y. Permanent address: Pikesville, Md.
- Harry Layfield Bell, E.E., Norfolk, Va.
- William Ragan Binkley, E.E., in charge of Switchboard, Mutual Automatic Telephone Co., Albuquerque, N. M. Permanent address: Hagerstown, Md.
- Bertine Frederic Borhek, A.C., West Bethlehem, Pa.
- Charles Schwartze Bowers, E.E., with J. F. Buchanan & Co., Electrical Contractors, Philadelphia, Pa. Residence: 1606 North 15th Street.
- John Boyt, B.S. (in Metallurgy), Assistant in Metallurgy, Lehigh University. Residence: 431 Cherokee Street, South Bethlehem, Pa.

- William Burke Brady, M.E., Harrisburg, Pa.
Walter Everette Brown, E.E., Stamford, Conn.
Sinclair Wiggins Chiles, C.E., Sims City, Florida.
Thomas Holland Clagett, B.S. (in Metallurgy), with the
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Ross Nathaniel Hood, E.E., Duncannon, Pa.

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Harry Sackett Johnson, E.E., with the Niagara Falls Power Co., Niagara Falls, N. Y. Residence: 264 3d Street.

Henry Harrison Jones, C.E., Reading, Pa.

Lawrence Rust Lee, M.E., Shepherdstown, W. Va.

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William Adams Megraw, M.E., Baltimore, Md.

Esteban A. Mercenario, C.E., Puebla, Mexico.

Thaddeus Merriman, C.E., employed on Nicaragua Canal Survey. Present address: care of Nicaragua Canal Commission, Army Building, New York City. Permanent address: South Bethlehem, Pa.

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- Henry H. Newton, M.E., 2043 Chestnut Street, Philadelphia, Pa. Permanent address: Guadalajara, Mexico.
- Robert Collyer Noerr, C.E., Brookland, D. C.
- Harry Richards Peck, M.E., Apprentice, D. L. & W. Shops, Scranton, Pa. Residence, 1523 Prince Street.
- James Harkins Pennington, M.E., Baldwin Locomotive Works, Philadelphia, Pa. Residence: 219 DeKalb Square.
- Morris Havens Putnam, M.E., with the Lehigh Construction Co., Limited, Massena, St. Lawrence Co., N. Y.
- John Peake Reynolds, jr., M.E., draftsman, Maxwell Wyeth & Co., (Gas Engines), 65 Delevan St., Brooklyn, N. Y. Residence: 404 Quincy St. Permanent address: Charleston, S. C.
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- Eugene Peronnean Roundey, C.E., with W. S. Bacot, C.E., 1 Broadway, New York City. Residence: 100 West 85th Street.
- Woodford Royce, M.E., Draftsman with the Morrison Co., Willimantic, Conn. Residence: 140 Church Street.
- Auguste Leopold Saltzman, M.E., with Walter Scott & Co., Printing Machine Works, Plainfield, N. J. Residence: 231 East 6th Street.
- Charles Fred. Sanders, C.E., Kutztown, Pa.
- Charles Francis Scott, E.E., with the New York and Staten Island Electric Co., New York City. Residence: New Rochelle, N. Y.
- Henry Hamilton Seabrook, E.E., Electrician for the New Jersey and Pennsylvania Concentrating Co., care of Thomas A. Edison, Edison, N. J. Permanent address: Beaufort, S. C.
- Samuel Palmer Senior, C.E., with SooySmith & Company, Consulting and Contracting Engineers, Cornwall, Ontario.
- Arthur Harold Serrell, E.E., with the Wheeler Condensing and Engineering Co., Carteret, N. J. Residence: 122 Plainfield Avenue, Plainfield, N. J.

- Frank Bradley Sheaffer, C.E., New Bethlehem, Pa.
John Leefe Sheppard, jr., M.E., Charleston, S. C.
Edward Peter Shuman, C.E., 129 South 5th Street,
Allentown, Pa.
Jonathan Edward Slade, C.E., 292 Ohio Street, Chicago,
Ill.
Francis Betts Smith, M.E., Hartford, Conn.
Harvey Wilson Sprague, M.E., Draftsman, Bethlehem
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Thomas Cedwyn Thomas, B.S. (in Mining), Assistant in
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Wallace Treichler, C.E., in charge of construction, Rock
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William Edward Underwood, M.E., with F. R. Dravo &
Co., Engineers and Contractors, Lewis Block, Pitts-
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Harrison Ricord Van Duyne, E.E., City Engineer's Office,
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Charles Parker Wagoner, C.E., Phoenixville, Pa.
John Eugene Weideman, E.E., Washington, D. C.
Gilbert Case White, C.E., with the Chesapeake and Ohio
R. R. Permanent address: 1 Clay Street, Rich-
mond, Va.
George Livingston Yates, E.E., with New York Telephone

Co., 15 Dey St., New York City. Residence: 318 West 57th St.

Ambrose Everett Yohn, M.E., with the Huntingdon and Broad Top Mountain Railroad and Coal Co. Residence: Saxton, Pa.

Frank Steinmetz Young, E.M., Plymouth Meeting, Pa.

The number of graduates is 960, degrees having been conferred as follows:

Upon graduates of the School of General Literature: B.A., 47; B.S., 22; Ph.B., 7; M.A., 9

Upon graduates of the School of Technology: C.E., 343; M.E., 195; B.M., 19; B.S. (in Mining and Metallurgy), 92; E.M., 72; E.E., 122; A.C., 92; B.S. (in Architecture), 11; M.S., 4; Ph.D., 2.

Of these, 9 have taken the degrees of B.A. and M.A.; 2 of B.S. and C.E.; 1 of B.S. and A.C.; 11 of B.M. and E.M.; 39 of B.S. and E.M.; 1 of B.M., E.M., and A.C.; 1 of B.S., E.M., and C.E.; 1 of C.E. and E.M.; 2 of A.C. and E.M.; 1 of A.C. and M.S.; 1 of B.S., E.M., and M.S.; 2 of A.C., M.S., and Ph. D. 920 graduates are still living.

ONE-YEAR COURSE IN ELECTRICITY.

Beginning with the year 1884-85, the University offered a special course in Electricity, covering one year's work. Those who completed this course received certificates but no degrees. In 1888, the full four-year course in Physics and Electrical Engineering, leading to the degree of E.E., was established, and the one-year course was withdrawn. The names of those who completed this course are not included in the Roll of Alumni, but are given here:

Elmer Ellsworth Boyer, '85, Foreman of Testing Department, General Electric Co., Lynn, Mass.

Albert Brodhead, '88, 121 South Centre Street, Bethlehem, Pa.

Edward Conner, '86, Philadelphia, Pa.

William Fairchild Dean, '88, Montreal Agent for Canadian General Electric Co., Ltd., 1802 Notre Dame Street, Montreal, Can. Residence: 351 Prince Arthur Street.
Horace Musser Engle, '85, (Economic Geology), Roanoke, Va.

Herman C. Frauenthal, '88, M.D., 214 East 50th Street, New York City.

Walter George Fuller, '87, Brattleboro, Vt.

John Wesley Hackney, '87, of the firm of Ashmead and Hackney, Civil Engineers and Surveyors, Room 42, Real Estate & Law Building, Atlantic City, N. J.

James Arthur Heaton, '86.

Richard Otto Albert Heinrich, '88, General Manager, European Weston Electrical Instrument Co., Ritterstrasse 88, Berlin, Germany.

William Hoopes, '86, Manager of Philadelphia office of The American Electrical and Maintenance Co., 44 North 4th Street, Philadelphia, Pa.

Joseph Allison Horner, '88.

William Henry Hubbard, '88, General Agent, Helios Electric Co., 1229 Callowhill Street, Philadelphia, Pa.

Walter Eugene Hyer, '86, Westfield. N. J.

Daniel Henry Jenkins, '88, M.D., 1932 North Main Avenue, Scranton, Pa.

Charles Leavitt Jenness, '85, Western Electric Co., Chicago, Ill.

William Sigler Jones, '87, Secretary, The Quaker City Electric Co., 237-239 Dock Street, Philadelphia, Pa. Residence: 5144 Wayne Avenue.

George Herman Koehler, '85, Standard Underground Cable Co., Pittsburg, Pa.

Robert McAllister Lloyd, '86, Electrical Engineer, 22 Broad Street, New York City.

Dion M. Martinez, jr., '87, Reading R. R. Co., Philipsburg, Centre Co., Pa.

Charles Jacob Meade, '86, Edison Electric Illuminating Co., 48 West 20th Street, New York City.

Charles Jacob Miller, '88.

- James Leidy Moore, '88, Superintendent, The Moorestown Electric Light, Heat and Power Co., Moorestown, N. J.
- George Harrison Neilson, '86, Supervisor, Division No. 3, Philadelphia Div., P. R. R., Parkesburg, Pa.
- Horace Fields Parshall, '87, Edison General Electric Co., Schenectady, N. Y.
- George Herbert Putnam, '85, Instructor in Physics and History, Texas School for the Deaf, Austin, Tex.
- Charles Norris Robinson, '88, Insurance Agent, 420 Walnut Street, Philadelphia, Pa.
- Harry Meyer Seitzinger, '88, Manager of Machine and Electrical Department, J. G. Seitzinger Screen and Machine Works, 6 Northampton St., Wilkes-Barre, Pa.
- Arthur Douglas Spear, '87, Brush Electric Co., Cleveland, O.
- Lewis Buckley Stillwell, '85, Electrical Director, Cataract Construction Co. and Niagara Falls Power Co. Niagara Falls, N. Y.
- Charles Wesley White, '88.
- George Henry Wolle, '87.
- Hugh Carlyle Young, '88, Superintendent Wellsboro Electric Company, Wellsboro, Tioga County, Pa.

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The Register is sent to all graduates who furnish their addresses for the purpose, and to all other persons on application to

THE SECRETARY OF THE LEHIGH UNIVERSITY,
South Bethlehem, Pa.